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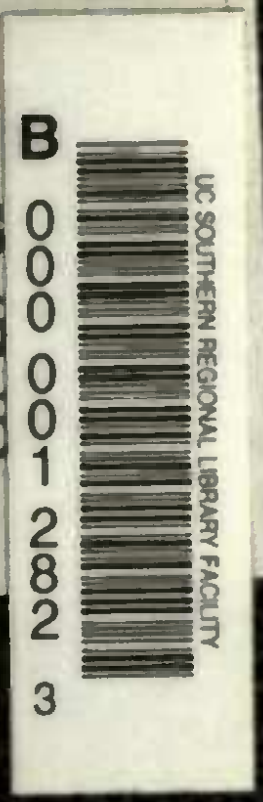

OF THE GLOBES

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Fig. 1.

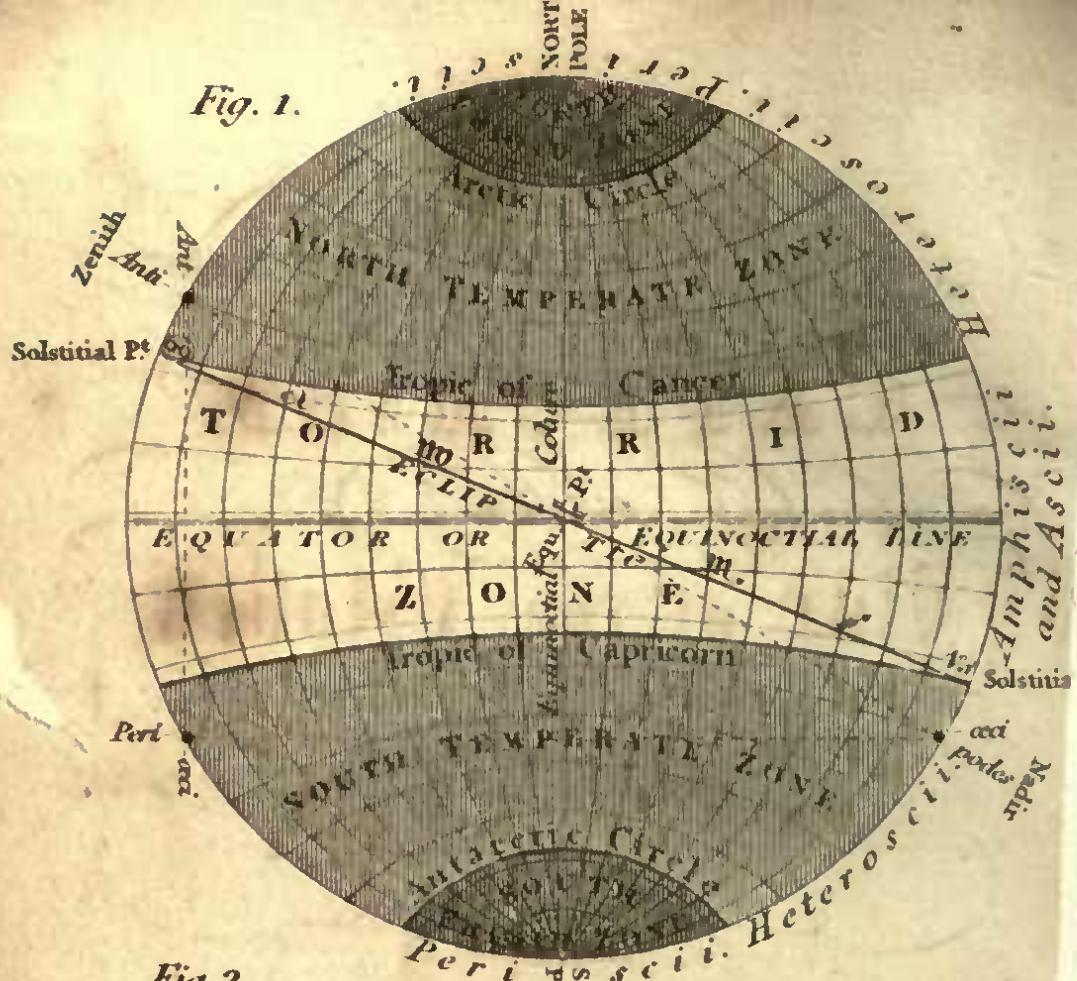


Fig. 2.

Ecliptic or Earth's Path among the Stars.

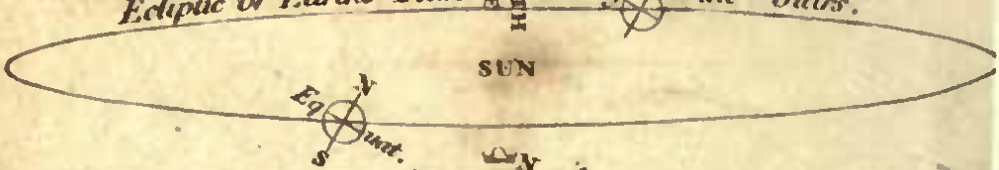
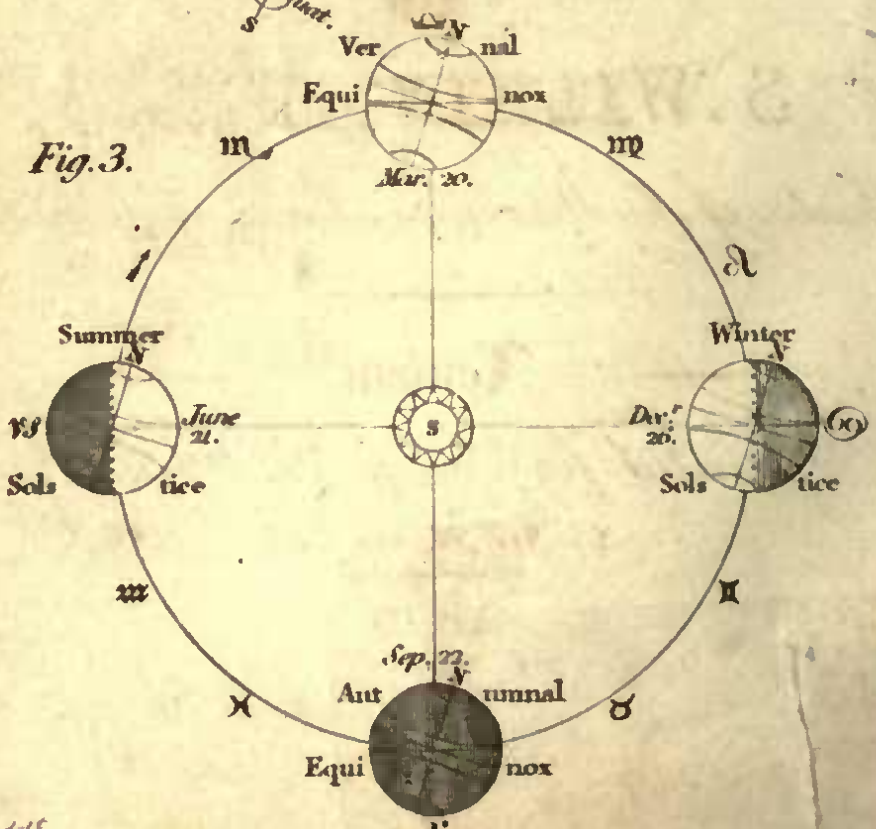


Fig. 3.



A CATECHISM of the Use of the Globes,

in Two Parts.

Part I.

ON THE TERRESTRIAL GLOBE.

By

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CATECHISM

OF THE

USE OF THE GLOBES.

Introduction.

Question. What is the USE OF THE GLOBES?

Answer. It is that practical department of study, in which we are taught the methods of applying instruments, called the TERRESTRIAL and CELESTIAL GLOBES, to the acquisition of Geography and Astronomy. By the former of those Instruments, we are enabled more clearly to comprehend the figure and motions of the Earth, together with the situation of places on its surface:—by the

latter, to observe the relative position of the fixed Stars, with the boundaries of the Constellations into which they have been divided; and to mark the varying position of the Planets. The USE of the GLOBES, therefore, is to be considered subsidiary to Geography and Astronomy, and not to be ranked as a distinct Science.

Q. For what purposes is the *Terrestrial Globe* employed?

A. It is employed, FIRST, to determine the *actual* and *relative* situation of all places on the Earth's surface. SECONDLY, to explain the Phenomena which take place on the Earth—resulting from its double motion, on its axis, and round the sun.

ON THE USE OF THE

TERRESTRIAL GLOBE.

PART THE FIRST.

The Terrestrial Globe used to determine the actual and relative situation of all places on the Earth's surface.

CHAP. I.

Its use in determining the ACTUAL situation of all places on the Earth's surface.

SECTION 1.

Introductory Questions.

Q. What is the *Terrestrial Globe?*

A. The Terrestrial Globe is designed by its figure and mechanical construction to represent the Earth and its motions: the map, with which the globe is covered, exhibits faithfully the continents and islands, seas, lakes, and rivers, with which the earth is diversified

by nature, together with the cities, towns, and villages which Art has, in the course of so many ages, scattered over its surface.

Q. How can the smooth paper map, with which the globe is covered, represent the earth's surface, on which there is so many high mountains?

A. These mountains, lofty as they appear, are so extremely inconsiderable when compared with the vast extent of our earth, that they no more affect its smoothness than grains of sand would that of the globe.

Q. Give a description of the figure and construction of the *Terrestrial Globe.*

A. The Terrestrial Globe is a *Sphere,* covered with a map, which represents the surface of the Earth, and is marked with the *Parallels of Latitude & Meridians of Longitude,* the *Equator* and *Ecliptic.* It turns round on its *axis,* by means of two pins, (representing the *Poles,*) in a brass ring, called the *Brass Meridian;* which is divided into degrees and minutes,

and moves up and down in two notches of a flat rim of wood, called the *Horizon;* this divides the globe into two equal parts, called the upper and lower *hemispheres;* one notch is in the North, the other in the South point of the horizon, the upper surface of which (about two or three inches wide,) exhibits, in several concentric circles, the months and days of the year, *Signs of the Zodiac, Points of the Compass,* and *Divisions of a Circle.* The Globe is furnished with a *Quadrant of Altitude, Horary Circle,* and sometimes a *Compass.*

Q. You have said that the Terrestrial Globe is constructed as a representation of the Earth; but are these various appendages to the Globes, which you have described,—parallels, meridians, equator, ecliptic, poles, &c., really to be found on the Earth?

A. By no means; they are only imaginary. Geographers, for the better determining the distances and situations of places, have imagined these Circles, Lines, and Spaces, to exist on the Earth's surface, and have

therefore drawn them on the Globe, and distinguished them by these various names.

Q. What is a *Sphere?*

A. A Solid, formed by the rotation of a Circle* about its diameter, which becomes the *Axis* of the Sphere.

Q. What is a *Great Circle?*

A. A Plane† passing through the Centre of a Sphere, dividing it into two equal parts.

Q. What is a *Less Circle?*

A. A Plane† passing through any other part of a Sphere than its Centre, dividing it into two unequal parts.

Q. What are the *divisions* of a Circle?

A. Every Circle is supposed to be divided into 360 equal parts, called *Degrees;* each of which is subdivided into 60, called *Minutes.* Degrees are thus marked° Minutes thus ′;

Q. What are the *Poles?*

A. The two extremities of the Earth's Axis.

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* A shilling, for example, suspended on two pins, at its opposite edges, and blown round, forms a Sphere in revolving.

† Used here rather to express the circumference, than the plane space included within it.

One of these, for distinction's sake, is denominated the *North Pole*, and the other the *South*.

Q. What are *Parallels of Latitude?*

A. Lesser Circles, parallel to the Equator. All places, directly East and West of each other, are said to be in the same Parallel of Latitude.*

Q. What are *Meridians of Longitude?*

A. Semicircles, drawn from one Pole to the other.

The Brass Meridian may represent the Meridian of any place.

Q. What is the *Equator*,† or Equinoctial Line?

A. A great Circle, equally distant from either Pole, dividing the Northern from the Southern hemispheres.

Q. What is the *Quadrant of Altitude?*

A. A narrow strip of thin brass, equal in length to 90°, or one-fourth of the Equator,

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* Every Place has its parallel of latitude; but the parallels usually drawn on globes and maps are the two Tropics, the two Polar Circles, and others intermediately at every ten degrees.

† The Equator is called by the Mariners, *the Line;* and when they sail over it, they are said to *cross the Line;* an event celebrated by them with many ridiculous and disgusting ceremonies.

and divided into degrees and minutes. It is used in measuring the distances of places, the altitudes of the Stars, &c.

Q. What are the *Horary*, or *Hour Circles?*

A. Small Circles of Brass, with the hours of the day marked on them.

In some Globes, they are placed on the brass Meridian, and furnished with an Index, which turns round with the Pole; in some, they slide on the brass Meridian; in others, they are under the brass Meridian, on the surface of the Globe.

Q. What is the *Horizon?**

A. The Horizon, with reference to the Globe, is a flat Rim or Circle of Wood, which enables us to vary at pleasure the inclination of the Globe, elevating or depressing either Pole, by means of the brass Meridian, which slides up and down, in two opposite notches, cut in the Horizon's inner edge. In working problems, this Circle represents what is termed the *Rational Horizon*, the line which divides the upper from the lower hemisphere, distinguishing day from night: which determines

* The term horizon is frequently used to describe that circle which bounds our sight on all sides, where the earth and sky

also the rising and setting of Sun, Moon, and Stars. It is a great Circle, 90 degrees distant from the Zenith.

Q. What are the *Zenith* and *Nadir?*

A. The Poles of the Horizon; or those two points which are equally distant from every point of it.

The *Zenith* is that point in the Heavens which is directly over our heads; the *Nadir* is its opposite, that point which is under our feet.

Q. What are the *Points of the Compass*, which you have said are marked on the Horizon?

A. The Compass, or, more properly, Mariner's Compass, is a box containing a magnetic needle;—a piece of steel, (usually shaped like an arrow,) which, having been rubbed on a magnet,* possesses the property of always

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appear to meet: this is called the *Sensible* or *Apparent Horizon*, and its extent varies with the spectator's elevation above the earth. Supposing the Earth to be level, an eye five feet above its surface will see only two miles and a quarter round, and at seventy feet, five miles and three quarters.

* The Magnet, or Loadstone, is a kind of stone usually met with in iron mines. It was discovered five or six hundred years ago, and was found to possess the extraordinary properties of attracting iron, and of pointing to the Poles of the Earth; which properties it communicates to iron, placed near to, or rubbed upon it.

pointing to the North. This needle is suspended horizontally on an upright point, so as to revolve freely: under it, and serving as an index to its movements, is a paper which covers the bottom of the box: on this paper is engraved a circle, and within it a star of 32 points, dividing the circle into four great divisions, called the Cardinal Points, and each of those into eight other Divisions, called Rhumbs.

Q. For what purpose are these points marked on the Horizon?

A. To enable the student to determine the bearing of any place relatively to any other; that is, whether it is North, South, &c., of that place.—Globes are often furnished with a Compass besides; by the help of which the Globes may be placed due North and South, or, in other words, so that the North Pole of the Globe may point to the North.*

* In doing this, attention must be paid to an extraordinary anomaly in the polar tendency of the Magnet, which was first remarked by Sebastian Cabot, and is called the variation of the Compass or its declination *from* the Pole.—At London, the needle varies to about two points West of the North.

SECTION 2.

Explanatory Questions and Problems.

Q. What do you mean by the *Actual Situation* of any place?

A. The situation it occupies on the Earth's surface, called its Latitude and Longitude.

Q. What is the *Latitude* of a place?

A. Its distance from the Equator, measured on a line drawn through it from the Equator to the Pole, which line is its Meridian. The Latitude is called North, if the place is situated North of the Equator; South, if the reverse.

Q. What is the *Longitude* of a place?

A. The distance (measured on the Equator) from *its* Meridian to the *first* Meridian: if the place be East of the first Meridian, the Longitude is East; if the reverse, West.

Q. What is the *first Meridian?*

A. That from which the degrees of Longitude, East or West, are numbered. The

Meridian of any place may be reckoned as the *first*, and the Longitude of a place would of course be different, as reckoned from different Meridians.

Ferro and the Isle of Palms, (two of the Canaries,) and the Peak of Teneriffe, have been adopted by different Geographers; but it is most usual in England to reckon from Greenwich, and in other countries from their Metropolis.

Q. How do you find the Latitude and Longitude of any place on the Globe?

A. Bring the given place to the Brass Meridian, the degree of the Meridian over the place shows its Latitude; that degree of the Equator which is cut by the Meridian gives the Longitude.

Remember that all places North of the Equator, have *North Latitude*—those to the South of it, *South Latitude*. Places are said to be in *West Longitude*, which are situated West of the first Meridian—those which are situated eastward of it, are in *East Longitude*.

Q. How do you find on the globe a place whose Latitude and Longitude are given?

A. Bring the given Longitude to the Brass Meridian; then, under the given Latitude on the Brass Meridian is the place sought.

Q. How do you find the difference of Latitude or Longitude between two places?

A. If the Latitudes or Longitudes are of the same name,* subtract the less from the greater: if of different names,† add them together, and should their sum exceed 180°, subtract it from 360° for the true difference.

Q. How do you find, on the globe, what places have the same Latitude as a given place?

A. Bring the given place to the Meridian—and all the places which in a revolution of the globe pass under that point, have the same Latitude.

Q. How do you find what places are of the same Longitude as a given place?

A. Bring the place as before to the Meridian—and mark all those places then under it, for the answer.

Q. How is the globe elevated for the Latitude of any place?

A. If the given place has North Latitude,

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* Both West or East Longitude—both North or South Latitude.
† One West, the other East Longitude;—one North, the other South Latitude.

elevate the North pole as many degrees as are equal to it, above the North point of the Horizon—if the Latitude is South, the South Pole must be elevated above the South point of the Horizon:—then, in either case, the place being brought to the meridian, is thereby placed in the Zenith, and the globe elevated for its Latitude as required.

Questions for Exercise in the First Chapter.

1. In what Latitude and Longitude did Nelson die?

2. At what Latitude and Longitude did Columbus effect his first landing in the new world?

3. Required the Latitude and Longitude of the spot which gave birth to Napoleon Buonaparte,—of the city in which he was crowned,—of the scene of his final overthrow,—and of his grave?

4. In what Latitude and Longitude was Pompey defeated by Julius Cæsar?

5. Required the Latitude and Longitude of the Meadow on which Magna Charta was signed?

6. Required the Latitude and Longitude of the spot on which Francis I. of France was made prisoner by the Emperor Charles V.?

7. In what Latitude and Longitude did Sir John Jervis obtain that victory, over the Spanish Fleet, which gave him his title?

8. In what Latitude and Longitude did James Cook, the great circumnavigator, fall by the hand of a savage?

9. William Penn, the celebrated Quaker, received from the British Government a grant of land in North America; there he founded the City of Philadelphia, between the two rivers, Skuylkill and Delaware: what is its Latitude and Longitude?

10. Chimborazo in America, Mount Blanc in Europe, the Peak of Teneriffe in Africa, and Himalaya in Asia, are the highest

mountains in the four quarters of the World: determine their Latitudes and Longitudes.

11. Tell the Latitude and Longitude of Etna and Vesuvius, the celebrated Volcanoes.

12. Botany Bay was discovered in 1770, and first settled in 1787: name its Longitude and Latitude.

13. The Latitude and Longitude of the field on which Edward the Black Prince, in 1346, won the motto, Ich Dien—*(I serve,)* which has since been worn by all the Princes of Wales?

14. One of the most extensive fisheries in the world, that of Newfoundland, was commenced in 1517: in what Latitude and Longitude?

15. Mexico was discovered in 1518—Peru in 1526—tell their Latitudes and Longitudes.

16. The Friendly Isles were named by their discoverer, Captain Cook, in 1773; the Society Isles in 1767: what are their Latitudes and Longitudes?

17. In Surinam is found the Torpedo; its rivers abound with Alligators, its forests with Monkeys:—determine the Latitude and Longitude of its chief town, Paramaribo.

18. Colour M'Crain, the oldest man on record for upwards of 3000 years, lived and died in the Island of Jura, where he kept 180 Christmases in his own house:—in what Latitude and Longitude did he die?

19. Louisa Truxo, aged 175, was alive in 1780, at Tucuman in South America: in what Latitude and Longitude?

20. London, the British Metropolis,—Ispahan, the capital of Persia,—Jeddo, that of Japan, and Nankin, the third city in China,—contain each about one million of inhabitants; Canton, the second city in China, contains a million and a half; and Pekin, its capital, two millions:—add to these particulars respecting the most populous places in the World, their respective Latitudes and Longitudes.

21. Name the extreme northern and south-

ern points hitherto discovered, of each of the four quarters of the globe, with the Latitudes and Longitudes of each of those points.

22. The Isthmus of Suez separates the waters of the Mediterranean from those of the Red Sea; and thus, by a few miles of barren sand, our merchants are compelled to make a very long voyage in order to arrive at our Indian dominions, by way of the Cape of Good Hope to Cape Comorin, which point they might otherwise have reached in nearly half the distance. Inform me the Latitudes and Longitudes of the places I have named; viz. Suez,—the two opposite extremities of the Mediterranean and Red Seas,—Cape Comorin, and the Cape of Good Hope.

23. Gold is found in the neighbourhood of Rio Janeiro, in the Brazils;—in Mozambic, Monomotapa, and Sofala, in Africa; —in the Island of Niphon, and the rivers of Thibet in Asia;—both gold and Silver, at Potosi, La Plata, and Guananal, in America; in Schlavonian Bossina, and at

Königsberg in Europe;—what are the respective Latitudes and Longitudes of these places?

24. Required the Latitudes and Longitudes of the Diamond Mines of Golconda; the Quicksilver Mines of Almaden in Spain, and Idria in Carniola; the Iron Mines of Tabern, and Danmora, in Sweden; the Copper Mines of Swedish Dalecarlia, Parys in Anglesea, and Ecton in Derbyshire; the Tin Mines of St. Agnes and Dartmoor, in Cornwall and Devonshire; and the Lead Mines of Upper Louisiana (North America,) Arkingdale in Yorkshire, and Wanlock-head, in Dumfriesshire, Scotland.

25. Tell the Latitude and Longitude of the natural Bridges, at Icononza, over the Rio de la Summa Paz in the Andes, and in the County of Rockbridge, Virginia.

26. The Hospice of Great St. Bernard is the highest inhabited ground in the old World, and the City Quito in the New:—Required the Latitude and Longitude of each.

27. The following are some of the principal Libraries in ancient and modern times—I wish to know the Latitude and Longitude of each. That of Ptolemy Philadelphus, at Alexandria, contained 700,000 volumes; of Eumenes, at Pergamus, 200,000; of Constantine at Constantinople, 300,000,—which were all burnt!—the Vatican at Rome, founded in 1450; that of Cosmo de Medicis, at Florence; of Bessarion at Venice; the Imperial at Vienna; Royal at Paris: the Bodleian at Oxford; the Ambrosian at Milan; the Library at Wolfenbuttle; and his Majesty's Library, in London.

28. Single Battles have frequently decided the fate of Empires. That of Zama, in Africa, between Hannibal and Scipio, terminated the power of Carthage; that of Pharsalia, the commonwealth of Rome; the Battle of Pydna reduced the Kingdom of Macedon to a Roman Province; the celebrated battle of Marathon terminated the Invasion of Greece, under Darius; that of Platæa, the subsequent Persian

Invasion, under Xerxes; at the battle of Arbela, Alexander the Great destroyed the Empire of Darius the Mede; the battle of Hastings terminated the Saxon Heptarchy; of Bosworth Field, the wars between the Houses of York and Lancaster; of Naseby, the struggle between Charles I. and the Parliament; and that of WATERLOO closed the extraordinary career of Napoleon Buonaparte. Required the Latitudes and Longitudes of all these places.

29. The Amazon, the largest river in South America, derives its source from the Eastern slope of the Andes, near La Paz, on the lake of Titicaca; flows 3375 miles, and enters the Atlantic near the Equator: in its estuary is the Isle of Caviana,—on its banks stand Curupa, Paru, Pauxis, Yarapa, St. Miguel of Conibas, Reves, Challana, and Atparaca.—The Mississippi, the largest river in North America, rises near Upper Red Cedar Lake, 150 miles West of Lake Superior. Its branch, the Missouri, rises among the rocky mountains;

joins the Mississippi at St. Geneviève, in the Illinois, and passes New Orleans, after a course of 3365 miles.—The great African river Nile is supposed to have its source in the Mountains of the Moon. It flows 2600 miles, and, after passing Grand Cairo, divides into several branches.—Alexandria, Aboukir, Rosetta and Damietta, are the most remarkable places at its entrance to the Mediterranean; the two last guarding its two principal mouths. The Yang-tse Kiang, or Great River, the largest in Asia, rises in Thibet, at Hourka, on the borders of the desert of Cobi; it flows 2990 miles; passes Tougtchuen, Mahou, Tchongking, Kingtcheou, Hanyang, and Nanking; its mouth is in the bay of Nankin. The largest river in Europe is the Volga, which rises in the Valday mountains, at Ostachkos, becomes navigable at Tver, and, after flowing 2035 miles, and passing Larostavl, Kostroma, Novgorod, Sinbirsk, and Saratov, it enters the Caspian at Astracan.—Give the Latitudes and Longitudes of all the places mentioned.

Q. What places have the following Latitudes and Longitudes?

30. 30° 3′ N. Lat. 31° 21′ E. Long.
31. 46° 47′ N. Lat. 71° 10′ W. Long.
32. 19° 26′ N. Lat. 100° 6′ W. Long.
33. 34° 29′ S. Lat. 18° 23′ E. Long.
34. 15° 55′ S. Lat. 5° 49′ W. Long.
35. 48° 50′ N. Lat. 2° 20′ E. Long.

Q. What is the difference between the Latitude and Longitude of

36.—Archangel and Bergen.

37.—Cape Comorin and Cape Horn.

38.—Manilla and Canton.

39. Suppose a balloon to leave London and proceed in a course due East, till it should again reach London——over what principal places would it have passed?

40. What places have nearly the same Latitude as St. Helena?

41. What places have nearly the same Longitude as Dublin 42.——St. Petersburg 43.—Ispahan.

CHAPTER II.

The use of the Terrestrial Globe in determining the RELATIVE Situation of Places on the Earth.

SECTION 1.

Introductory Questions.

Q. What do you mean by the *relative situation* of any point on the earth's surface.

A. Its *situation compared with any other point.* Thus, when we speak of the Antœci, Periœci, or Antipodes of any place, we mean to express certain relations which they bear to that place, in situation.

Q. What are the *Antœci?*

A. The term Antœci signifies *those who dwell opposite each other:*—places on the same Meridian of Longitude, and in equal but opposite Latitudes, the one North, the other South of the Equator.

Q. What are the *Periœci?*

A. *Those who live on the same circle:*—Places on the same Parallel of Latitude, but in opposite points of Longitude.

Q. What are the *Antipodes?*

A. Antipodes, like the two preceding terms Antœci and Periœci, is derived from the Greek, and signifies *those who have their feet opposite to each other*;—Places at the greatest possible distance from each other, on opposite Meridians of Longitude, and of equal, but opposite Latitudes.

Q. What do you mean by the *Angle of Position* between two places?

A. The Angle formed between the Meridian of one of those places, and a Great Circle passing through both of them.

SECTION 2.

Problems.

Q. How do you find the Antœci of any place on the Globe?

A. Bring the given place to the Brass Meridian: and having found its Latitude, count as many degrees from the Equator, towards the opposite Pole, on the same Meridian;—the point thus arrived at, will be the Antœci required.

Q. How do you find the Periœci of any place on the Globe?

A. Bring the given place to the Brass Meridian, and set the Index to the upper 12; turn the Globe till the Index points to the under 12—then the place which is under the Brass Meridian, at the same Latitude as the given place, will be the Periœci required.

Q. How do you find the Antipodes of any place, by the Globe?

A. Find the Antœci to the given place: the Periœci to the Antœci, so found, will be the Antipodes required.

Q. How do you find the distance and the Angle of Position, between two places?

A. Elevate the Globe for one of the places, and if the other be then above the Horizon, (or, in other words, if the distance between the two places be less than 90°) screw the quadrant of Altitude over the place which you have brought to the Meridian; move the quadrant over the other place, and observe what degree is cut by it. *Subtract* that num-

ber from 90° for the distance required—and the quadrant will shew on the Horizon the Angle of Position. If, however, when the Globe has been elevated for one place, the other is not above the Horizon, (the distance between the places being more than 90°) elevate the Globe for the Antipodes of one of the places, and having fixed the quadrant as before, bring its edge over the other place, and *add* the degree cut by it to 90° for the distance required: the point on the Horizon opposite to that cut by the quadrant will give the Angle of Position required. The distance in degrees is reduced to English miles, by being multiplied by 69½.

The distance between places of nearly similar Latitudes may be determined by finding the difference of their Longitudes, which may be reduced to English or to Geographical miles—a rule,* according to their Latitudes—or by reference to the table at the end, giving the

* *Rule.* Multiply the length of a degree of Longitude at the Equator by the natural cosine of the Latitude; the product is the length of a degree of Longitude at that Latitude.

length of a degree of Longitude at any Latitude. For example: the difference of Longitude between North Cape in Europe, and East Cape in Siberia, is about 175°—the Latitude being about 70°, this difference will give 3500 Geographical, or 3725 English, miles; but the distance between these two places, found by the quadrant, according to the given rule, is 42°, or 2940 miles.

Questions for Exercise in the Second Chapter.

44. What are the Antœci of Malta?

45.—of Quebec? 46.—of Cape Horn?

47.—of Azof?

Required the Antœci of the following Longitudes and Latitudes, viz.

48. 114° E. Long. 22° S. Lat.

49. 9° W.—— 39° S. ——

50. Required the Periœci of Newcastle upon Tyne. 51.—Quito in South America. 52.—St. Petersburg.

Required the Periœci of the following Longitudes and Latitudes, viz.

53. 179½° E. Long. 45° N. Lat.

54. 84° E. Long. 19° N. Lat.

55. 116° W.—— 40° N.——

56. What are the Antipodes of London? 57.—of Otaheite? 58.—of Pekin?

What are the Antipodes to the following Longitudes and Latitudes? viz.

59. 73° W. Long. 6° N. Lat.

60. 98° E—— 23° S. ——

61. 177° E. —— 56° S. ——

62. Required the distance and Angle of Position, between London and Copenhagen.

63. Between London and Stockholm.

64. ———————— Constantinople.

65. How long is Europe, from the Rock of Lisbon on the West, to the Oural Mountains on the East?

66. What is the breadth of Europe and Asia, from North Cape in Iceland, to East Cape in Tchoukchi?

67. What is the breadth of Africa, from Cape Verd, in the West, to Cape Guardafui, in the East.

68. What is the breadth of North America,

from the Promontory of Alashka to Cape Charles, the extreme point of Labrador?

69. What is the breadth of South America, from Cape Blanco, in Peru, to Cape St. Roque in Brazil?

70. What is the length of the West coast of America, from Cape Horn to Icy Cape?

71. What is the distance between Cape Verd in Africa, and Cape Roque in America?

72. What is the distance between Panama in America, and Manilla, one of the Philippine Islands?

73. What is the distance between the island of Bombay and Nootka Sound?

74. How far is London from Calcutta?

75. The following is the track pursued by Captain Cook, in his first voyage round the world,—required its length in English miles.

From Portsmouth to Cape Verd Isles

Cape Verd Isles to Cape Horn

Cape Horn to Otaheite

Otaheite to New Zealand, Cape South

From New Zealand, Cape South, to Port Hicks, in New Holland

Port Hicks, in New Holland, to Endeavour Straits

Endeavour Straits to Batavia, in Java

Batavia, to the Cape of Good Hope

Cape Good Hope to Ascension Island

Ascension Island to the Azores

Azores to England.

76. The following is the track pursued by Capt. Cook, in his second voyage round the world,—required its length in English miles.

From Plymouth to Madeira

Madeira to St. Jago

St. Jago to off Cape Palmas

Cape Palmas to Cape Good Hope

Cape Good Hope to Dusky Bay, in New Zealand

Dusky Bay to Queen Charlotte's Sound

Queen Charlotte's Sound to Otaheite

Otaheite to Middleburg

Middleburgh to Queen Charlotte's Sound

From Queen Charlotte's Sound to S. Lat. 71° 10′ *W. Long. 106° 54′

Thence to Easter Island

Easter Island to St. Christina (Marquesas)

St. Christina to Huaheine

Huaheine to Anamocka

Anamocka to Aurora Island (New Hebrides)

Aurora Island to Island of Pines

Island of Pines to Cape Palliser (New Zealand)

Cape Palliser to Terra Del Fuego

Terra Del Fuego to Island of Georgia

Island of Georgia to Sandwich Land

Sandwich Land to Cape Good Hope

Cape Good Hope to St. Helena

St. Helena to Fernando Noronha

Fernando Noronha to Fayal (Azores)

Fayal to Portsmouth.

77. How many miles would be travelled in making the following tour of Europe?

* The highest Southern Latitude ever attained.

From Lisbon to Madrid
Madrid to Paris
Paris to London
London to Brussels
Brussels to Amsterdam
Amsterdam to Berlin
Berlin to Copenhagen
Copenhagen to Stockholm
Stockholm to St. Petersburg
St. Petersburg to Moscow
Moscow to Vienna
Vienna to Venice
Venice to Turin
Turin to Florence
Florence to Rome
Rome to Naples
Naples to Constantinople.

78. How many miles would the traveller add to his tour by proceeding in the following route, from

Constantinople to Aleppo
Aleppo to Damascus
Damascus to Jerusalem

From Jerusalem to Mecca
Mecca to Bassora
Bassora to Babylon
Babylon to Ispahan
Ispahan to Cabul
Cabul to Cashmere
Cashmere to Delhi
Delhi to Burhampoor
Burhampoor to Hydrabad
Hydrabad to Seringapatam
Seringapatam to Madras
Madras to Calcutta
Calcutta to Siam
Siam to Canton
Canton to Nankin
Nankin to Pekin
Pekin to Lefou
Lefou to Okhotsk
Okhotsk to Tobolsk
Tobolsk to Moscow.

79. In passing round the globe, on the Tropic of Cancer, beginning from the Isle of Formosa, and proceeding westward,—through what countries and towns would you pass,—

across what principal rivers,—over what lakes and seas;—tell the length of your tour, by reckoning in miles the successive distances between each town, river, lake, &c. which may be mentioned throughout the Tour: giving also the separate extent of every country, island, and sea?

80. A Circumnavigator on the Equator, proceeding from the Meridian of Greenwich eastward,—would first cross the Atlantic—and land in the mouth of the Amazon,—he would traverse Portuguese Guiana, cross the river Blanco, its eastern boundary, and proceed through New Granada, over the Negro, Yupura, Putu Mayo, and Azuelo, (branches of the Amazon,) and after crossing the Andes, at Quito, to the shores of the Great Pacific Ocean, he would embark at the Borrachos; he would soon reach the Gallapagos Islands, and thence passing somewhat South of Hopper's Isle, arrive at the Moluccas, of which he would first make Wayoogee Island,—cross the Isle of Geby, that of Gilolo, (at Pool,) and

that of Celebes, (landing at Tidon, and embarking at Cape Temoel,)—he would then cross the centre of Borneo and Sumatra, two of the largest Islands in the world;—landing at Costa Brava in the former, crossing the great river of Tenoa, and embarking again at Tamahoo—landing at Cramper in Sumatra, and embarking at Passaman.—He would, after leaving Sumatra, cross the Island of Minloan, in the Indian Ocean, and find no other land till he reached the shores of Africa, halfway between Patte and Magadoxa,—after crossing the unexplored part of the continent of Africa, he would again embark at Gamon, completing the circuit at the meridian of Greenwich.—Required the several distances from place to place, and the total length of his course, in miles.

*** Many of the latter questions may be used as questions for Latitude and Longitude.

END OF PART THE FIRST.

ON THE USE OF THE

TERRESTRIAL GLOBE.

PART THE SECOND.

The Terrestrial Globe used to explain the Phenomena which take place on the Earth,—resulting from its double motion, on its Axis and round the Sun.

CHAP. I.

Introductory and explanatory questions.

Q. What is the *Ecliptic*?

A. A *Great Circle*, describing the Sun's apparent path in the Heavens.—It cuts the Equator, obliquely, at an angle of 23½ degrees. Speaking perhaps more strictly, the Ecliptic is that path or way among the fixed stars, which the Earth would appear to describe, to an eye placed in the Sun.—*See fig.* 2.

Q. What are the *signs of the Zodiac?*

A. Twelve equal parts of the Ecliptic, each containing 30°, thus marked and named*:—

	SPRING.		
NORTHERN.	Aries, the Ram	. . . . .	♈
	Taurus, the Bull	. . . . .	♉
	Gemini, the Twins	. . . . .	♊
	SUMMER.		
	Cancer, the Crab	. . . . .	♋
	Leo, the Lion	. . . . .	♌
	Virgo, the Virgin	. . . . .	♍
	AUTUMN.		
SOUTHERN.	Libra, the Balance	. . . . .	♎
	Scorpio, the Scorpion	. . . . .	♏
	Sagittarius, the Archer	. . . . .	♐
	WINTER.		
	Capricornus, the Goat	. . . . .	♑
	Aquarius, the Waterman	. . . . .	♒
	Pisces, the Fishes	. . . . .	♓

The Winter and Spring Signs are called *Ascending*, the Summer and Autumn, *Descending* Signs.

Q. What are the *Tropics?*

A. Two less circles, parallel to the Equator,

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* The order of the signs is thus described by Dr. Watts:

The RAM, *the* BULL, *the heavenly* TWINS,
And, next the CRAB, *the* LION *shines,*
The VIRGIN, *and the* SCALES:
The SCORPION, ARCHER, *and* SEA-GOAT,
The MAN THAT HOLDS THE WATERPOT,
And FISH *with glittering tails.*

and 23° 28′ distant from it. That which is on the North side of it, is called the Tropic of Cancer, that which is South, the Tropic of Capricorn.—*See fig.* 1.

Q. What are the *Polar Circles*?

A. Two less circles, parallel to the Equator, 23° 28′ from either pole—the Northern called the Arctic—the Southern, the Antarctic—Circle.—*See fig.* 1.

Q. What are the *Equinoctial Points?*

A. Those at which the Equator and Ecliptic cross each other—the first points of Aries and Libra.—*See fig.* 1, which exhibits, of course, only one of those points.

Q. What are the *Solstitial Points?*

A. Those at which the Ecliptic touches the Tropics—the first points of Cancer and Capricorn.—*See fig.* 1.

Q. What are the *Colures?*

A. The Meridians which pass through the Solstitial and Equinoctial points—called the Solstitial and Equinoctial Colures.—*See fig.* 1,

where the line from pole to pole exhibits half the Equinoctial Colure—and where the Solstitial Colure is the line which circumscribes the globe.

Q. What is the *Sun's declination?*

A. Its distance, North or South, from the Equator.

Q. What is the *Sun's Altitude?*

A. Its elevation above the Horizon.

Q. What is the *Analemma?*

A. A calendar of months and days so divided as to indicate the Sun's declination through the year. It is usually marked on some vacant part of the globe.

Q. In what time does the Earth revolve on its Axis?

A. In 24 hours moving from West to East; —this is called the Earth's *diurnal motion.*

Q. In what time does the Earth move round the Sun?

A. In about 365¼ days;—this is called its *annual motion.*

Q. Of what figure is the path which the Earth describes in moving round the Sun?

A. Of an elliptical figure;—this path is called the Earth's *orbit.*

Q. In what position is the Earth, while performing its annual motion? Is its axis upright?

A. No; it is always inclined about $23\frac{1}{2}^{\circ}$ from a line perpendicular to the Earth's orbit. This is called (with reference to the Globes,) the obliquity of the Ecliptic to the Equator.

Q. What are the effects produced on the Earth by its diurnal and annual motion?

A. From the former, results the succession of light and darkness, with intermediate twilight—from the combination of both, arises the vicissitude of seasons; and these phenomena enable us to divide time.

Q. How does the Earth's diurnal motion cause the succession of light and darkness?

A. By that motion, the Earth successively brings every place on its surface *into* the Sun's light, and carries it *away from* it.

Q. What is the cause of twilight?

A. The refraction of light. The Earth is surrounded by a thin fluid, called the atmosphere, possessing the property of bending (or refracting) the rays of light which pass through it. Hence, the rays of the sun, falling on the upper part of the atmosphere, are bent down towards the surface of the Earth, and occasion, for a certain time before sun-rise, and after sun-set, that partial or imperfect light which we call twilight.

Q. Why does the combined operation of the diurnal and annual motions occasion the vicissitude of seasons?

A. Because the obliquity of the Earth's axis produces inequality of day and night at different periods of the year. If the Earth's axis were *upright* the Sun's ray's would fall equally on both poles—thereby always illuminating exactly one half of each hemisphere, so that every place on the earth would have equal light and dark in the 24 hours, twilight

excepted. But in consequence of the obliquity of the Earth's axis, this happens on two days of the year only; at all other times, one of the poles is turned away from the Sun, and consequently more than half of one hemisphere is always in darkness: while an equal portion of the other is in light: hence, all places on the Earth (except those upon the Equator,) experience an unequal quantity of light and dark on every day of the year but two.

Q. Why are not the inhabitants of the Equator liable to those inequalities of day and night which all others experience?

A. Because they are always placed in a right sphere, that is, have the poles of the world in the Horizon. In such a position all the declination circles are bisected by the Horizon; whatever, therefore, is the Sun's declination, the portion of its apparent rotation in which it is above the Horizon is equal to the portion below the Horizon.

By rectifying the globe to the position of a *right sphere*, that is, by placing both poles in

the Horizon, it will instantly be perceived that in such a situation all the parallels of Latitude as well as the Equator are *bisected* by the Horizon, consequently every place on the earth will be exactly as long *above* as *below* the Horizon, in each diurnal revolution;—in other words—will have equal day and night. Let the globe be then placed in the position of an *oblique sphere*—that is, with either pole elevated above the Horizon (to correspond, of course, with the given declination of the Sun,) and it will as clearly be seen that the Equator only, but none of the parallels of Latitude are bisected by the Horizon,—consequently, no place situated on any other parallel than the Equator, can be as long above as below the Horizon in each revolution—in other words, can have equal day and night—but on two days, when, the Sun being on the Equator, the Earth is, to all its inhabitants, in the position of a right sphere.

Q. In what order do the Seasons succeed each other through the year?

A. In the Northern Hemisphere, they succeed each other in the following order.*

WINTER begins on the 21st of Dec.—*the shortest day*,—when the Sun enters *Capricorn*; this is the *Winter Solstice*. From this period, the Sun moves through the ascending signs and the days increase in length. *Day and night* become equal on the 21st of March, when the Sun enters *Aries:* this is the beginning of SPRING, and is called the *Vernal Equinox*. *The days* after this become *longer than the nights*, till the 21st of June, when the Sun enters *Cancer*, and SUMMER begins; this is the *Summer Solstice, and longest day*. From this time the days decrease in length, through the descending signs, till *day and night* are again *equal* at the *Autumnal Equinox*, 23rd of September, when the Sun enters *Libra*, and AUTUMN begins. *The days* are, after this, *shorter than the nights*, till the shortest day, returning, completes the revolution.

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* See figure 3:—observe, the Earth is in the sign opposite to that which the Sun is said to enter.

Q. How is time divided?

A. It is divided into *years* and *days*, by the Sun's annual and diurnal motion. The *year* is divided into twelve *months*; agreeing in number with the signs, and in duration nearly corresponding with the period of the Moon's revolution round the Earth. *Days* are divided into 24 *hours*, in each of which the Sun moves through 15° or the 24th part of 360°, the complete revolution. It is called noon at any place, when its Meridian is opposite the Sun. Places 15° eastward of a given place, will have noon one hour *sooner*, and those 15° westward, one hour *later* than that place.

Q. What are the *Zones*?

A. Five parts or portions so called, into which the Earth is divided by the Tropics and Polar Circles, and whose Inhabitants are distinguished by the different directions in which their shadows are thrown. They are the *two Frigid Zones*, lying within the *Polar Circles*, whose inhabitants are called *Periscii*, signify-

ing "with shadows round about," because, when the day is more than 24 hours long, they are successively thrown on every side, by the Sun's motion round them. The *two Temperate Zones*, lying between the Tropics and Polar Circles, whose inhabitants are called *Heteroscii*, signifying "with shadows different ways," those in the North Temperate Zone, having their meridian shadows always on the North, those in the South Temperate Zone, always on the South side of them. Lastly, the *Torrid Zone*, lying between the Tropics, whose inhabitants are called *Amphiscii*, which signifies "with shadows on both sides," because their meridian shadows fall sometimes northward, sometimes southward, as the Sun is south or north of them: and twice a year, when the Sun is vertical, they have no shadow, and are called *Ascii*, "without shadows."

Q. What are *Climates?*

A. A climate is a portion of the Earth's

surface contained between two parallels of Latitude, and of such a breadth, that the longest day in that parallel nearest the Pole, exceeds the length of the longest day in the other parallel boundary, (next the Equator,) by some exact space of time; those which differ by half an hour, are called hour climates; those whose difference is a month, are called month climates.

Q. Into how many climates has the Earth been divided?

A. Into 30 in each hemisphere; viz. 24 between the Equator and the Polar Circles,—the hour climates; and 6 within the Polar Circle,—the month climates. They increase in width successively, as they are nearer the Equator.

CHAPTER II.

Problems.

Q. Having the hour given at any place, how do you find what time it is at another place?

A. Bring to the Brass Meridian the place at which the hour is given, set the Index to

that hour; turn the globe till the other place comes to the Meridian, and the index will give the hour required.

Q. How do you know whether the hour thus found, is an afternoon or forenoon hour?

A. Suppose the required place to be *west* of the given place, then the hour found will be *earlier* than the given hour; thus, suppose Greenwich at noon, to be the given place and hour, then in the mouth of the Missisippi, which is 90 degrees *west* of Greenwich, it will be six o'clock in the *morning;* in the mouth of the Ganges, which is 90 degrees *east* Longitude, it will be six in the *afternoon.*

Q. And what time will it be then at the Fox Islands—the Periœci to Greenwich?

A. Midnight.

Q. And again, suppose Greenwich on the 1st Jan. 1821, at noon, to be the place and time given, then will it be midnight of the *same* or of *the preceding* day, at the Fox Islands

—in other words, will it be Dec. 31st, 1820, or Jan. 1st, 1821?

A. This depends on whether you sail to the Fox Islands by an easterly or westerly course. For example, a vessel which had sailed from Greenwich eastward, and reached its Perioeci when it was noon at Greenwich, would reckon it to be midnight on the same day, Jan. 1st. 1821; while a vessel arriving there at the same moment having come in an opposite direction, would reckon it to be midnight Dec. 31st, 1820. It will be observed that this explanation strictly accords with the answer to a preceding question. The Perioeci to any place, if considered as being 180° west of the place will have 12 hours *earlier* time: but when considered 180° east of it, will have 12 hours *later* time; and in like manner, a place 90° west of Greenwich, if spoken of as being 270° east of it (or if sailed to in an easterly direction,) instead of being 6 in the morning of the same day, or in other words 6 hours *earlier*, will be 6 o'clock in the morning of the follow-

ing day, in other words 18 hours *later* time.

Q. Suppose one vessel to sail from Greenwich, Westward, and another, Eastward;—each to set sail Jan. 1st, at noon; and suppose them each to proceed in the same Latitude, and to sail round the world according to their own reckoning, in 24 days: how would their reckoning stand on their return to Greenwich? Here it will be seen that each vessel is supposed to arrive at Greenwich at 12 o'clock at noon: they will agree as to the hour, but what day of the month will they call it?

A. On Jan. 2nd, the ship which sailed *West* would have the Sun on the Meridian when it was *one* o'clock P. M. at Greenwich. On Jan. 3rd, when it was *two* o'clock P. M. at Greenwich:—and so, each succeeding day, noon on board this ship would be an hour later (as to the reckoning kept at Greenwich) than on the former day.—On Jan. 13th this ship would reach the Periœci to Greenwich, and would have the Sun on the Meridian, when at Green-

wich it was midnight of Jan. 13-14; that is, it would be noon on that 12 hours later on board the vessel, than at Greenwich. On Jan. 14th, according to the reckoning on board this ship, the Sun would be on the Meridian 13 hours later than at Greenwich; that is, it would be the 14th at noon on board this vessel, when it was 1 o'clock in the morning of the 15th of Jan. at Greenwich:—consequently, when the vessel arrived at Greenwich, the ship's reckoning would be, Jan 25th at noon, but the reckoning at Greenwich would be Jan. 26th at noon.

On the contrary, the ship that sailed *East*, by meeting the Sun, would have it on the Meridian each day an hour earlier than on the former; so that on Jan. 2nd, the Sun would be on the Meridian when it was 11 A. M. at Greenwich on the 3rd, when it was 10 A. M. at Greenwich, and so on,—consequently on the 13th day, according to the ship's reckoning, the Sun would be on the Meridian at the Fox Islands, when it was midnight between the 12th and 13th of Jan. according to the reckon-

ing at Greenwich; and therefore on the 14th of Jan. the Sun would be on the Meridian, according, to the ship's account, when it was 11 P. M. of Jan. 13th, according to the reckoning at Greenwich. Hence on the 25th, when the ship arrived at Greenwich, it would, according to the reckoning kept there, be only Jan. 24th.

From each vessel the Sun would be seen to rise, come to the Meridian, and set, 24 times; but one of them is supposed to sail *with* the Sun and the other *against* the Sun, which would occasion one to *gain* a day, and the other to *lose* a day. Thus the ship which sailed *East* would have the Sun on the Meridian 24 times, while the Earth made only 23 revolutions; but the Earth must make 25 revolutions in order that the ship which sailed *West* might have the Sun 24 times on the Meridian.

Hence arises the apparent paradox, that the ship which sailed *West* and went round the world (according to the supposition,) in 24 days, finds that according to the reckoning at Greenwich, 25 days have elapsed since they

set sail; and that the ship which sailed *East* at the same rate of sailing finds that at Greenwich their absence was only called 23 days!

The following incident may serve still more clearly to illustrate the subject.

In the year 1789, a mutiny took place on board a British vessel, called the Bounty, sent to convey bread-fruit to the British Colonies in the West Indies: the Mutineers, after turning the commander, Lieut. Bligh, and 18 of the crew, adrift in the boat, proceeded to Otaheite, and from that Island eight of the Mutineers with their ringleader and some Otaheitans set sail, and were not heard of afterwards for twenty years. An American vessel touched at Pitcairn's Island in 1808, and there discovered the survivors of the lost Mutineers. Again in Sept. 1814, Sir Thomas Staines and Captain Pipon, of H. M. ships Briton and Tagus, fell in with this Island. The day on which the two captains landed was Saturday the 17th of Sept., but by John

Adam's* account, it was Sunday the 18th, and they were keeping the Sabbath by making it a day of rest and prayer. This was occasioned by the Bounty having proceeded thither by the eastern route, and our frigates having gone by the western; the Topaz found them right according to her own reckoning, she having approached the Island by the eastern route. Every ship from Europe proceeding to Pitcairn's Island, round the Cape of Good Hope, will find them a day later—those who approach them round Cape Horn, a day in advance,—as was the case respectively with Captain Folger and the Captains Sir T. Staines and Pipon.

Q. Having the hour given at any place, how do you find where it is noon?

A. Bring the place to the Meridian, set the Index to the hour:—turn till the Index points to 12, at noon:—the places under the Meridian, are those required.

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* The Chief of the Colony, and only surviving Englishman of those who quitted Otahelte.

Q. How do you find the Sun's place in the Ecliptic?

A. Find the date of the month, in the Calendar on the Horizon, against which, on the adjoining circle, will be found the sign and degree in which the Sun is on that day. Find the same sign and degree, in the Ecliptic; and this is the Sun's place required.

If this be required with greater accuracy, consult White's Ephemeris for the year.

Q. How do you find the Sun's declination?

A. Bring the Sun's place to the Meridian; the degree over it will be the declination.

Q. How do you rectify the Globe for the Sun's place, and day of the month?

A. Find the Sun's declination for the given day;—elevate the pole of the same name as the declination, as many degrees as are equal to it.

Q. How do you find the Sun's rising and setting for any given day, at any given place?

A. Elevate the Globe for the latitude of the place, bring the Sun's place to the Meridian, and set the Index to 12. Turn the Globe till

the Sun's place comes to the Eastern edge of the Horizon, the Index will show the time of rising. Bring the Sun's place to the Western edge, and the Index will show the hour of sunset.

Q. How do you find the Sun's Meridian altitude, at any given place, for any given day?

A. Elevate the Globe, bring the Sun's place to the Meridian, fix the quadrant of Altitude in the Zenith, and bring it over the Sun's place; then the degree on the quadrant, cut by the Sun's place, will be the Meridian altitude required.

Q. How do you find the Sun's altitude for any hour, on a given day, at a given place?

A. Elevate for the Latitude, bring the Sun's place to the Meridian, and set the Index at noon. Turn till the Index points to the given hour, and the quadrant of altitude will shew the altitude as in the last problem.

Q. How is the Latitude of a place found, having the Sun's Meridian altitude, on any particular day at that place, given?

A. Bring the Sun's place to the Meridian, and move the Globe up or down, till the distance between the Sun's place, and the North or South point of the Horizon (as the case may require) is equal to the given altitude; the Pole will then be elevated to the Latitude required.

Q. The Latitude and day being given, how do you find when the Sun is due East or West?*

A. Elevate for the Latitude; bring the Sun's place to the Meridian, and set the Index to 12. Fix the quadrant in the Zenith; and bring it, if the Latitude and declination be of the same name, to the East point of the Horizon. Turn the globe, till the Sun's place comes to the edge of the Quadrant; then the Index gives the time required. When the Latitude and declination are of different names, bring the Quadrant to the West point of the Horizon for the result. In both cases subtract the answer

* Observe that this happens sometimes when the Sun is below the Horizon.

from 12, and the remainder will be the time of due West.

Q. How do you find, by the Globe, on what two days in the year the Sun is vertical to a given place in the Torrid Zone?

A. Observe the two points of the Ecliptic, which, in one revolution of the Globe, pass under the given Latitude on the Brass Meridian. The days in the Calendar corresponding with those two points are the days required:—or thus; bring the Analemma to the Meridian, and under the given Latitude, the Analemma will give the day required.

Q. How do you find to what place the Sun is vertical at a given day and hour?

A. Find the places where it is noon at the given time. Of these, that place will have the Sun vertical, whose Latitude is the same as the Sun's declination.

Q. How do you find when the Sun begins to appear above the Horizon—and when to disappear—at any place in the North Frigid Zone?

A. Rectify for the Latitude—Then, that

point of the *Descending* Signs, which, in turning the Globe, will be cut by the *South* point of the Horizon, will give the day on which the LONGEST NIGHT begins. That point of the *ascending* signs so cut, will give the day of its termination. In the same way, that point of the *ascending* signs cut by the *North* point of the Horizon, will give the *beginning*, and that in *descending* signs cut by the North point will give the *end*, of the LONGEST DAY.

Q. Having the length of the longest Day at any place given, how do you find the Latitude of the place?

A. Bring the first point of Cancer to the meridian: set the Index to 12. Turn westward till the index points to the hour of Sunset, i. e. half the length of the day; raise, or depress the Pole till the Sun's place is in the western Horizon, the Globe will then be rectified for the Latitude required.

By this Problem, the limits of the Hour Climates are found —For example find where the longest day is twelve hours and a half long—then where it is thirteen hours long—the parallels of these two places will form the limits of the first Hour Climate; and so on in succession.

Q. Having the greatest number of days from Sunrise to Sunset given, at any place where the Sun does not set for some days, how do you find the Latitude?

A. Count half as many degrees as the given number of days, from the first of Cancer towards the Equator—bring the point arrived at, to the Meridian—subtract the number (on the Meridian) under which it passes from 90°—the result will be the Latitude required, *nearly*.

Q. Having a place and hour given, how do you find where the Sun is rising, where it is setting, where it is noon, where it is twilight, and where midnight?

A. Find the place to which the Sun is vertical, and place it in the Zenith. To all places in the Western semicircle of the Horizon, the Sun is rising—in the Eastern, setting; to those under the Meridian above the Horizon, it is noon, and below the Horizon midnight. To all places 18 degrees below the Horizon, it is twilight.

Q. How do you find the duration of twilight at any place, on any given day?

A. Rectify for the Latitude, bring the place to the Meridian, and the Index to 12. Turn till the Sun's place is 18° below the Horizon, the Index will tell the commencement of twilight, which subtracted from Sunrise will give the duration of twilight.

Q. How can you find at what places an Eclipse of the Moon is visible at a given time?

A. Bring the Antipodes of the place to which the Sun is vertical, to the Zenith. The Eclipse will be visible at all places then above the Horizon.

Questions for Exercise in the Preceding Chapter.

81. When it is 3 o'clock P.M. at London, what is it o'clock at Boston, in America?

82. What is it o'clock at Pekin, when it is 9 in the morning at Lisbon?

83. At noon in London, what is it o'clock in the Society Isles?

84. Where is it noon when it is 5 P. M. at Paris?

85. Where is it noon when it is 1 A. M. at New Zealand?

86. When half past 6 A. M. at Quebec, where is it 11 A. M.?

87. What is the Sun's place for March 10th?

88. —— for June 4th?

89. —— for Sept. 9th?

90. Required the Sun's declination for January 31st?

91. —— for March 10th?

92. —— for September 22nd?

93. Required the time of Sunrise and Sunset at Edinburgh on the 1st of June?

94. —— at London July 17th?

95. What is the Sun's Meridian altitude June 21st at Archangel?

96. —— same day, at Bombay?

97. Required the Sun's altitude at Jerusalem, October 21st, at 10 o'clock A. M.?

98. —— at St. Petersburgh June 21st, at 6 o'clock P. M.?

99. Where is the Sun's meridian altitude 74° 24′ North, on the 5th of August?

100. When is the Sun due East and West at London, at the Summer and Winter Solstices?

101. On what days is the Sun vertical at St. Helena?

102. To what places is the Sun vertical April 16th and August 28th?

103. —— March 20th and Sept. 23rd?

104. When does the Sun begin to appear above the Horizon, at North Cape in Lapland Lat. 72° North—when does it disappear, and how long are its inhabitants without seeing it?

105. What is the length of the longest day at the North Pole?

106. In what Latitude is June 21st 16 hours long?

107. In what Latitude does the Sun shine continually for 50 days?

108. On April 27th, 6 hours, 45 minutes, A. M. at Newcastle, required the places to which the Sun is rising and setting; also where it is noon, and midnight?

109. How long does twilight continue at London on the following days, viz. March 2nd, and December 26?

110. On August 22nd, 1812, there was an Eclipse of the Moon, when it was 3 P. M. at London; where was it visible?

ANSWERS

to the Questions contained in the Catechism of

THE TERRESTRIAL GLOBE.

1.	36°	8′	N.	6°	3′	W.—Cape Trafalgar.
2.	24	30	N.	75	30	W.—Cat Island.
3.	42	0	N.	3	40	E.—Ajaccio in Corsica.
	48	50	N.	2	20	E.—Paris.
	50	36	N.	4	23	E.—Waterloo.
	15	55	S.	50	43	W.—St. Helena.
4.	39	22	N.	22	40	E.—Pharsalus.
5.	51	28	N.	0	20	W.—Runnymede.
6.	45	10	N.	9	11	E.—Pavia.
7.	37	1	N.	9	2	W.—Cape St. Vincent.
8.	19	20	N.	155	59	W.—Karakakooa Bay,
9.	39	56	N.	75	13	W. [Owhyhee.
10.	1	41	S.	78	30	W.—Chimborazo.
	45	52	N.	6	54	E.—Mont Blanc.
	28	28	N.	17	0	W.—Peak of Teneriffe.
	34	30	N.	76	0	E.—The Himalaya at the [source of the Jumno.
11.	37	37	N	15	0	E.—Etna.
	40	48	N.	14	24	E.—Vesuvius.
12.	33	51	S.	151	11	E.
13.	50	16	.	1	58	E.—Creçy.
14.	Between 46° 45′ and 51° 46′ N.					
	———— 52 31 and 59 40 W.					

15. Mexico may be considered as extending from the 10th to the 38th degree of North Latitude. Its Longitude varies with the shores of the North Pacific its Western boundary, and of the Atlantic and Gulf of Mexico its Eastern boundary. Mexico the Capital is in 19° 25′ N. 90° W.

Peru extends from 3° 30′ to 15° S. and from 60° 30′ to 81° W. Lima its Capital is in 12° 2′ S. 77° 71′ W.

16. The Friendly Isles extend from 19° 40′ to 21° 30′ S. and from 184° 46′ to 185° 45′ E.—The Society Isles from 16° 10′ to 16° 55′ S. and from 150° 57′ to 152° W.

17.	5°	50′	N.	55°	10′	W.
18.	56	0	N.	6	0	W.—nearly
19.	26	49	S.	64	36	W.
20.	51	31	N.	0	5	W.—London.
	32	25	N.	52	50	E.—Ispahan.
	36	30	N.	140	0	E.—Jeddo.
	32	4	N.	118	34	E.—Nankin.
	23	7	N.	113	14	E.—Canton.
	39	55	N.	116	28	E.—Pekin.

Answers to 21—29 *omitted.*

30. Cairo. 31. Quebec. 32. Mexico.
33. C. of Good Hope. 34. St. Helena. 35. Paris.
36. 4° 10′ Lat. 33° 16′ Long.

37. 63° 54′ Lat. 145° 31′ Long.

38. 8° 32′ Lat. 7° 51′ Long.

39. Breslaw, Warsaw, Koursk, and Saratov, in Europe; Orenburg, Irkutsk, and South Cape of Kamtschatka, in Asia; Aleouski or Fox Islands, between Asia and America; Queen Charlotte's Sound, on the West Coast of America; Strait of Belle Isle, in America, and Cork, in Ireland.

40. Middle of South Africa; Madagascar; North part of New Holland; New Hebrides; Society Islands; Middle of Peru and Brazil, in South America.

41. East Coast of Greenland; Faro Isles; Hebrides; Scilly Isles; Cadiz; Cape Palmas, in Africa: and the Isles of St. Matthew and St. Helena.

42. Moghilov, Rogatchov, Kiov, Akerman, Ismael, Alexandria, &c.

43. West Coast of Nova Zembla; East Coast of the Caspian Sea, Shiraz, in Persia; Morbat in Arabia; Isle of Socotra, Amirante Isles, and Isle of Bourbon.

44. Cape of Good Hope, nearly.

45. Patagonia, nearly. 46. Labrador

47. Prince Edward's Isles.

48. Macao in China. 49. Lisbon.

50. The Aleouski, or Fox Islands.

51. Podang, in Sumatra.

52. Prince William's Sound, North Coast of America.

53. Bourdeaux.

54. Vera Cruz.

55. Samarcand.

56. 179° 55′ E. 51° 31′ S. a little to the south

57. Near Dongola, in Africa. [of New Zealand.

58. Near the Mouth of the River Sanzes, in Patagonia. 59. Batavia.

60. Havannah in Cuba. 61. Edinburgh.

62. 9° or 625 miles. N. E. by E.

63. 13 or 903 miles. N. E. ½ E.

64. 22 or 1528 miles. E. S. E. ½ E.

65. 48 or 3336 miles.

66. 42 or 2940 miles.

67. 66 or 4587 miles.

68. 59 or 4100 miles.

69. 45 or 3127 miles.

70. The distance between the two places in a direct line is 136° or 9452 miles.—A vessel sailing in the shortest course from one place to the other, would sail about 10779 miles or 155°; but a coasting voyage would extend to upwards of 12500 miles—about 180 degrees.

71. 26° or 1807 miles.

72. 149° or 10355 miles.

73. 109 or 7575 miles.

74. The direct distance 71 degrees or 4934 miles. The voyage by the Cape of Good Hope about 195 degrees or 13640 miles.

Answers to 75—80 *omitted.*

81. 18 min. past 10 A. M.

82. 22 min. past 5 P. M.

83. 2 min. past 2 A. M.

84. Labrador, New England, and Pensylvania, in North America: Hispaniola; Terra Ferma, Peru, &c. in South America.

85. Iceland, Madeira, and Canary Isles, nearly; and Cape Verd.

86. Edinburgh, Gloucester, Bristol, Plymouth, Bilboa, Madrid, &c.

87. ♓ 20 7′ 88. ♊ 13° 57′ 89. ♍ 17°

90. 17° 14′ S. 91. 3° 54′ S. 92 0° 30′ N.

93. Sunrise 27 min. after 3. A. M.
Sunset 33 min. after 8. P. M.

94. 4 o'clock, A. M. 8 o'clock, P. M.

95. 48° 54′ S. 96. 85° 29′ N.

97. 38° 98. 20°

99. In 1° 36′ N.

100. Summer Solstice, *East* 7 h. 15 m. *West*

4 h. 45 m. Winter Solstice, *East* 4 h. 45 m. *West* 7 h. 15 m.

101. February 6th and November 6th.

102. Lake of Nicaragua, North part of South America, Coast of Guinea, Abyssinia, South part of the Peninsula of India, Magindanao, and other Philippine Isles, &c.

103. To all places on the Equator.

104. It appears 26th Jan. rises and sets daily till May 15th, continues above the Horizon from that time till July 29th; then it rises and sets daily till Nov. 16, when it entirely disappears till Jan. 26; the length therefore of the longest night is equal to 71 days.

105. Six months. 106. 49° N. 107. 69°

108. Rising—Greenland, the Azores, Cape Verd Isles, Ascension Isle. Setting—Fox Islands, Queen Charlotte's Islands, East Coast of New Holland. Noon—Middle of Siberia and of the Western Peninsula of India. Midnight—Middle of North America, Mexico.

109. Mar. 2, 1 h. 50 m. Dec. 26, 2 h. 10 m.

110. Asia, New Holland, New Zealand, &c.

Table to find the Length of a Degree of Longitude in any Latitude.

Deg.of Lat.	Geograph. Miles.	English Miles.	Deg.of Lat.	Geograph. Miles.	English Miles.	Deg.of Lat.	Geograph. Miles.	English Miles	Deg of Lat.	Geograph. Miles.	English Miles.
0	60·00	69·20	23	55·23	63 70	46	41·68	48·07	69	21·51	24·80
1	59·99	69·19	24	54·81	63·22	47	40·92	47·19	70	20·52	23·67
2	59·96	69·16	25	54 38	62·72	48	40·15	46·30	71	19·53	22·53
3	59 92	69·11	26	53·93	62·20	49	39·36	45·40	72	18·54	21·38
4	59·85	69·03	27	53·46	61·66	50	38·57	44·48	73	17·54	20·23
5	59·77	68·94	28	52·97	61·10	51	37·76	43·55	74	16·54	19 07
6	59 67	68·82	29	52·48	60·52	52	36 94	42·60	75	15·53	17·91
7	59 55	68·69	30	51·96	59·93	53	36 11	41·65	76	14·52	16·74
8	59·42	68 53	31	51·43	59·32	54	35·27	40 68	77	13·50	15·57
9	59·26	68·35	32	50·88	58·69	55	34 41	39·69	78	12·48	14·39
10	59 09	68 15	33	50 32	58·04	56	33·55	38 70	79	11·45	13·20
11	58 89	67·93	34	49·74	57 37	57	32·68	37·69	80	10·42	12·02
12	58 69	67·69	35	49·15	56·69	58	31·79	36·67	81	9·38	10·83
13	58·46	67·43	36	48'54	55·98	59	30·90	35·64	82	8·35	9·63
14	58·22	67·14	37	47·92	55·27	60	30·00	34·60	83	7·31	8·43
15	57·95	66 84	38	47·28	54·53	61	29·90	33·55	84	6·27	7·23
16	57·67	66·52	39	46·63	53·78	62	28·17	32·49	85	5·22	6·03
17	57·38	66·18	40	45·96	53·10	63	27·24	31·42	86	4·18	4·83
18	57·06	65·81	41	45·28	52·23	64	26·30	30·34	87	3·14	3 62
19	56·73	65·43	42	44·59	51·43	65	25·36	29·25	88	2 09	2·42
20	56·38	65·27	43	43·88	50·61	66	24·40	28·15	89	1 05	1·24
21	56·01	64·60	44	43·16	49·79	67	23·45	27·04			
22	55·63	64·06	45	42·43	48·93	68	22·48	25·92			

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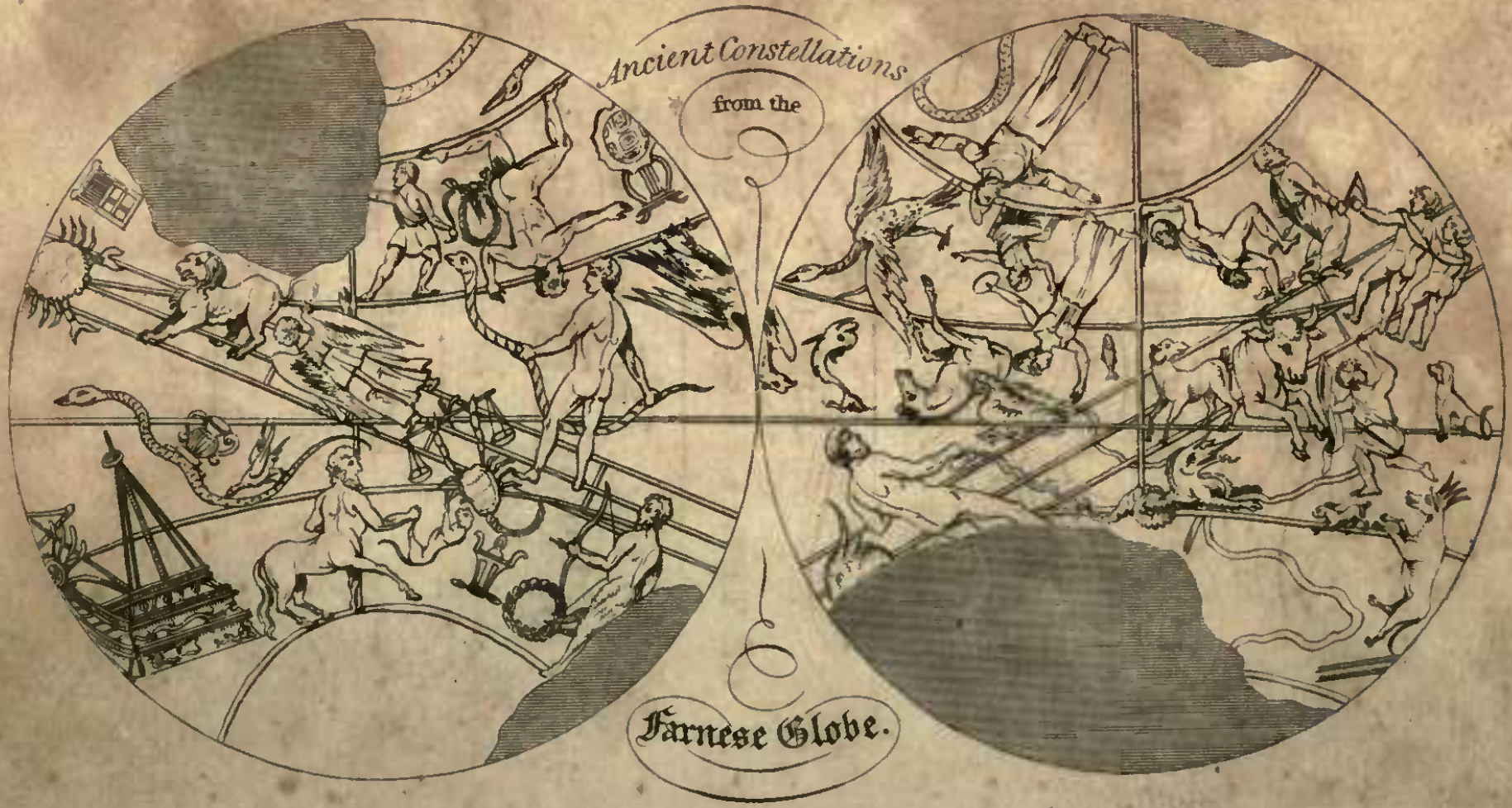
Ancient Constellations
from the
Farnese Globe.

A CATECHISM of the Use of the Globes, in Two Parts.

Part II.

ON THE CELESTIAL GLOBE.

By

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CATECHISM

OF THE

USE OF THE GLOBES.

ON THE USE OF THE

CELESTIAL GLOBE.

CHAP. I.

Introductory Questions.

Having explained the various uses of the TERRESTRIAL GLOBE, and illustrated the importance of that Instrument in facilitating the Study of Geography—we now enter upon the *second part* of our subject; in which we hope to point out methods of obtaining as valuable assistance from the CELESTIAL GLOBE in prosecuting the Study of ASTRONOMY.

stellations on the surface of the Sphere, as the Stars appear to a spectator on the Earth.

Q. What is a *Sphere?*

A. A Solid, formed by the rotation of a Circle about its diameter, which becomes the *Axis* of the Sphere.

Q. What is a *Great Circle?*

A. A Plane passing through the Centre of a Sphere, dividing it into two equal parts.

Q. What is a *Less Circle?*

A. A Plane passing through any other part of a Sphere than its Centre, dividing it into unequal parts.

Q. What are the *divisions* of a Circle?

A. Every Circle is supposed to be divided into 360 equal parts, called *Degrees*, each of which is subdivided into 60, called *Minutes*. Degrees are thus marked° minutes thus′.

Q. What are the *Celestial Poles?*

A. The extremities of the Earth's Axis extended to the Heavens—the two points around which the stars appear to revolve.

Q. What is the *Equinoctial?*

A. The Equator, supposed to be continued to the Heavens.

Q. What are *Parallels of Declination?*

A. Less Circles drawn parallel to the Equinoctial. They are the parallels of Longitude, supposed to be continued to the heavens.

Q. What are the *Celestial Meridians?*

A. Lines drawn from one Celestial pole to the other, directly across the Equinoctial; and are also called circles of Declination; they are the terrestrial meridians supposed to be continued to the Heavens.

Q. What is the *Declination* of a star or any other heavenly body?

A. Its distance north or south of the Equi

noctial, reckoned upon the meridian—in other words, it is an Arc of the Meridian contained between the equinoctial and the heavenly body spoken of.

Q. What is the *right ascension* of a Celestial object?

A. That degree of the equinoctial which comes to the meridian at the same time with the Star or Sun, reckoning from the first point of Aries, eastward: in a right Sphere, it is that degree of the equinoctial which comes to the *Horizon* with the Star or Sun.

Q. What is *oblique ascension?*

A. It is the point or degree of the Equinoctial which comes to the Horizon at the same time with the Star or Sun, in an *oblique Sphere.*

Right or oblique Ascension, as applied to the Sun or Stars, is expressed either in Degrees or Hours. It is that degree of the Equinoctial which comes with the Sun or Star to the Horizon——either in a right or an oblique Sphere. The distinction is this; in a right Sphere, that degree is *the same as* the Declination Circle of the Sun or Star; in an oblique Sphere it cannot of course be the same. The former, therefore, is *right*—the latter, *oblique Ascension.*

Q. What is *ascensional difference?*

A. The difference between *oblique* and *right* ascension. Expressed in the time it gives the Sun's rising before or after 6 o'clock.

Q. What do you mean by *right* and *oblique descension*, and *descensional difference?*

A. They have the same reference to the *setting* of the Sun, or of a Star, as the terms right and oblique ascension and ascensional difference have to its *rising*.

Q. What is the *Latitude* of a celestial Body?

A. The Latitude of a celestial Body, is its distance *north* or *south* of the Ecliptic.

Q. What are *Parallels of Celestial Latitude?*

A. Parallels of Celestial Latitude are *Less Circles* parallel to the Ecliptic.

Q. What is the *Longitude* of any celestial Body?

A. The Longitude of a celestial Body, is

its distance, reckoned eastward on the Ecliptic, from the first of Aries, and expressed in Signs, Degrees, and Minutes.

☞ The Ecliptic, it will be remarked, determines *celestial* Latitudes and Longitudes, while *geographical* Latitudes and Longitudes are reckoned from the Equator.

Q. What are *Circles of celestial Longitude?*

A. Circles of celestial Longitude are *great circles* perpendicular to the Ecliptic, and passing through its poles.

Q. Explain the terms *rising* and *setting* as applied to the heavenly bodies.

A. A celestial body is said to *rise* when its centre appears on the eastern part of the horizon; and to *set* when its centre disappears in the Western part of the Horizon.

Q. What is meant by *culminating?*

A. A celestial Body culminates when it comes to the Meridian.

Q. Explain the terms *Zenith and Nadir.*

A. *Zenith,* the Point in the Heavens

directly over our heads. *Nadir*, that Point directly over the heads of our Antipodes.

Q. What are *azimuth Circles*, or *vertical Circles?*

A. Great Circles which, passing through the Zenith and Nadir, are perpendicular to the Horizon. Fix the Quadrant for example on the brass Meridian, in the Zenith, and bring it to the Horizon; it will describe the Quadrant or quarter of a vertical, or azimuth circle.

Q. What is the *prime* vertical?

A. That vertical Circle which passes through the East and West points of the Horizon is called the Prime Vertical.

Q. How is the term *Azimuth* applied?

A. To express, with respect to any celestial body, the distance of its vertical Circle on the Horizon, East or West of the North or South points of the Horizon. It is an arc of the Horizon, contained between its North or South

points, and the vertical or azimuth Circle of the object in question.

Q. Define *Amplitude.*

A. The distance of any heavenly Body, when rising or setting, from the East and West points of the Horizon, is called the amplitude of that body, and is either North or South. Amplitude, like azimuth, is an arc on the Horizon the former being reckoned from the East or West point; the latter, from the North or South point of the Horizon.

Q. Describe the *Zodiac.*

A. It may be called a Belt of the heavens parallel to the Ecliptic, extending eight degrees on each side of its Centre. The Zodiac contains twelve Constellations, which are called Signs of the Zodiac.

Q. What is the *Altitude* of a celestial object?

A. The arc of a vertical circle contained

between the Centre of the Object and the Horizon.

Q. What is the *Zenith Distance?*

A. An arc of the vertical Circle, contained between the centre of the body and the Zenith. The altitude and zenith distance together make a quadrant of the vertical Circle.

Q. What is the *Meridian* Altitude or Zenith Distance?

A. It means the altitude or Zenith Distance when the object is on the meridian.

Q. What is the *Orbit* of a Planet?

A. The path that it describes in revolving round the Sun.

Q. How do you apply the terms *Conjunction* and *Opposition?*

A. A Body is said to be in conjunction, when it has the same longitude as the Sun; and in opposition, when the difference of Longitude is 180°.

Q. What is the Geocentric Place of a Planet?

A. Its place in the heavens, as seen from the Earth.

Q. What is its Heliocentric Place?

A. Its place as seen from the Sun.

Q. What is the Disc of the Sun or Moon?

A. Its circular face, which appears flat on account of its great distance from the Earth.

Q. What is a Digit?

A. The Twelfth part of the diameter of the Sun or Moon.

CHAPTER II.

Of the Fixed Stars.

Section 1.

Of the Origin of the Constellations—Enumeration of them.

Q. What is a *Constellation?*

A. A Group of Stars, situated contiguously, and distinguished by the name of some animal or other object to which their outline bears a fancied resemblance; or of some hero whose memory it was wished to perpetuate.

Q. How many Constellations are there?

A. Nearly one hundred.

Q. What is the origin of this method of observing and classing the fixed Stars?

A. It is probable that they were thus distinguished by figures and images in the very infancy of science. We read of some of the

important Stars and Constellations in the book of Job and in the Poems of Homer and Hesiod.

Q. To what nations then are we probably indebted for the rudiments of Astronomy; and who first cultivated this interesting branch of it?

A. The Chaldeans, the Egyptians, the Indians, and Chinese, severally claim the honor of having founded the Science: and the Phenicians and Greeks seems to have had a very early acquaintance with it.

Q. What Constellations are supposed to have been described by these nations?

A. The Chaldeans are believed to have had considerable share in arranging the Stars into Constellations. The Chinese are said to have invented the twelve Signs of the Zodiac, and to have given them the following names—the mouse, the ox, the tyger, the hare, the dragon, the serpent, the horse, the sheep, the monkey, the cock or hen, the dog, and the boar. They did not, however, mark their Constellations by

figures of the animals whose names they assigned to them; but in all their books of astronomy they defined the boundary of each constellation by connecting together all the Stars composing it with straight lines from Star to Star. They also divided the Heavens into twenty-eight Constellations. The Phenicians derived their astronomical knowledge either from the Chaldeans or the Egyptians; and were the first who applied it to navigation; making one of the Stars of the Little Bear their guide. From the Egyptians the science was carried into Greece by Thales the Milesian, and after him it was successively cultivated by Anaxagoras, Pythagoras, Philolaus, Meton, Archimedes, Ptolemy, &c.

Q. Enumerate the principal Constellations.

A. They may be divided into three classes; the Northern, the Zodiacal and the Southern Constellations. There are thirty-eight of the former, *viz.*—

Andromeda, Anser, Antinoüs, Aquila, Auriga, Boötes, Camelopardalus, Canes Venatici or *Asterion et Chara, Caput Medusæ, Cassiopeia, Cephus, Cerberus, Coma Berenices, Cor Caroli, Corona Borealis, Cygnus, Delphinus, Draco, Equulus, Hercules, Lacerta, Leo Minor, Lynx, Lyra, Mons Mænalus, Musca, Pegasus, Perseus, Sagitta, Scutum Sobieski, Serpens, Serpentarius* or *Ophiuchus, Taurus Poniatowski, Triangulum, Triangulum Minus, Ursa Major, Ursa Minor, Vulpecula.*

Of the Zodiacal Constellations there are twelve, *viz.*—

Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, Pisces.

And forty-seven of the Southern, *viz.*—

Apis or *Musca Australis, Apus* or *Avis Indica, Ara, Argo Navis, Brandenburgium Sceptrum, Canis Major, Canis Minor, Centaurus, Cetus, Chamæleon, Circinus, Columba Noachi, Corona Australis, Corvus, Crater,*

Crux, Equulus Pictorius, Eridanus, Fornax Chemica, Grus, Horologium, Hydra, Hydrus, Indus, Lepus, Lupus, Machina Pneumatica, Microscopium, Monoceros, Mons Mensæ, Norma or *Quadra Euclidis, Octans Hadleianus, Officina Sculptoria, Orion, Pavo, Phœnix, Piscis Australis* or *Piscis Notius, Piscis Volans, Praxiteles* or *Cela Sculptoria, Pyxis Nautica, Reticulus, Rhomboidalis, Robur Caroli, Sextans, Telescopium, Touchan* or *Anser Americanus, Triangulum Australe, Xiphias* or *Dorado.*

Q. How many Stars have been marked in these Constellations?

A. Above three thousand: viz. 1250 in the Northern, 850 in the Southern, and 1000 in the Zodiacal Constellations.

Q. And how many of them may be seen with the naked eye?

A. About a thousand.

Q. But are not a great many more visible

with the best telescopes, than have been marked in the Constellations?

A. The number of Stars visible through good telescopes may be said to be almost infinite. The Milky Way, which is a broad tract or path encircling the Heavens, is nothing but an assemblage of Stars too remote to be seen singly, but so closely disposed as to give a luminous appearance to that part of the Heavens. In the Milky Way Dr. Herschell has, in a quarter of an hour, seen 116,000 Stars pass through his telescope.

Q. What are the most remarkable Stars in the Northern Constellations?

A. The Stars of the first magnitude are, Arcturus in Bootes, Capella in the waggoner, Vega in Lyra, Deneb Adige in Cygnus, Altair* in Aquila, and Dubhee* in Ursa Major. Besides these, there are Stars of less magnitude remarkable in other respects. For example,

---

* By some Astronomers considered secondary.

Alruccabah, the north Polar Star, of the second magnitude; the last in the tail of Ursa Minor, and the variable Stars, Algol in Medusa's Head, a Star in the neck of the Swan, &c.

Q. What are the remarkable stars in the Southern Hemisphere?

A. Sirius, the Dog Star, which is the brightest in the Heavens, Fomalhaut, in Piscis Australis,—Achernar in Eridanus, Rigel and Betelgueze in Orion,—Canopus in Argo,—Procyon in Canis Minor, Cor Hydra,—to which some Astronomers add, a star in the Southern Cross, two in the fore feet of the Centaur, the eye of the Peacock.—In this hemisphere the star marked *o* in Cetus is a variable Star.

Q. What are the remarkable Stars in the Zodiacal Constellations?

A. Those of first magnitude are, Aldebaran in Taurus,—Regulus in Leo,—Antares in Scorpio,—Spica Virginis,—Castor in Ge-

mini,- and according to some Deneb in the Lion's Tail; but others make only the first three primary stars.

Q. What is the supposed distance of the nearest fixed Star?

A. So great, that our most accurate observations have not been able to determine it. It is conjectured that a cannon ball, moving with a velocity of 1000 feet per second, would be nearly two millions of years in passing from the Earth to the nearest fixed Star.

Q. Do the Stars appear, as their name implies, *fixed?*

A. No: they seem to move from east to west, (because the Earth revolves from west to east,) and in circles parallel to the equinoctial; so that when the Equinoctial is perpendicular to the Horizon, they rise and set perpendicularly, as may be seen by elevating the Globe for a right sphere.

Q. Do all the Stars partake of this apparent motion?

A. No: for in a right sphere the Polar Star will always be on the Horizon; and the other stars will rise and set.

Section II.

Problems relating to the fixed Stars.

Q. How are the right ascension and declination of any Star found?

A. By the following rule: bring the Star whose right ascension and declination are required, to the brass meridian; the declination is marked by the degree of the Meridian under which it passes: the degree of the Equator which is cut by the Meridian gives the right ascension.

Declination and right ascension being the same on the Celestial Globe as Latitude and Longitude on the Terrestrial, this problem is the same precisely as the first problem on the Terrestrial Globe; see p. 14, Cat. on Use of the Globes, Part 1.

Q. Is there any other mode of finding the right ascension of a Star?

A. If the Poles be brought to coincide with the Horizon, (in other words, if the Globe be elevated for a right Sphere) and the Star be brought to the Eastern Horizon, then the point of the Equator which comes to the Horizon at the same time will be the right ascension.

Q. Suppose the declination and right ascension of a Star given, how then do you point out the place of the Star on the Globe?

A. First, bring to the brass meridian the point of the Equator on which is marked the given right ascension, then under the given declination on the meridian is the place required.

Q. How are the right ascension and declination to be found or known, unless found by first having the Star pointed out on the Globe?

A. There are Catalogues of Stars with their right ascension and declination given, of which the Student may avail himself, and will find this Problem of great use to render him

familiar with the names and relative situations of the principal Stars.

Q. How are the Latitude and Longitude of a Star found?

A. Bring to the brass meridian that Pole of the Ecliptic which is in the same hemisphere as the Star, and fix over it the Quadrant of Altitude: keep the Globe fixed, and move the Quadrant till it comes over the given Star, then the degree of the Quadrant cut by the Star is its Latitude, and the degree on the Ecliptic cut by the Quadrant is its Longitude.

Q. What is the Boundary between the Northern and Southern Hemisphere?

A. The Ecliptic; a Star south of the Equinoctial may have north Latitude, and one that is north of the Equinoctial may nevertheless be in south Latitude.

Q. Suppose the Latitude and Longitude of a Star given, can you thereby point out the Star?

A. By exactly reversing the problem, as in the case of the declination and right ascension.

Q. On a given day, how can you tell at what hour any Star comes to the Meridian?

A. By first bringing the Sun's place to the Meridian, and setting the Index to 12 o'clock. Then turning the Globe round till the Star comes to the brass Meridian, the Index will point to the hour required.

If the Star be to the east of the Sun, the hour will be *p. m.*: if to the west of the Sun, it will be *a. m.*

Q. If a given Star passes the Meridian at a given hour, can you thereby determine the day of the month?

A. Yes; by the following method:—bring to the meridian the given Star, and set the Index to the given hour:—then turn the Index till it points at noon: the day required will be discovered by observing what degree of the ecliptic is then under the meridian.

Q. Having the Latitude, the day of the

month and hour of the night given, how can you find the altitude and azimuth of any Star?

A. Elevate the Globe for the given Latitude, bring the Sun's place to the meridian, and set the Index to twelve. Turn the Globe till the Index points to the hour given. Fix the Quadrant of altitude in the Zenith, and bring it over the Star: then the degree upon the Quadrant which is cut by the Star, will give its altitude—and the distance between the foot of the Quadrant and the north or south points of the Horizon will be the azimuth required.

Q. Suppose the azimuth and the day of the month given—then how can the hour of the night and Star's altitude be found for a given latitude?

A. Elevate the Globe for the Latitude, bring the Sun's place to meridian, and set the Index to twelve. Fix the Quadrant of altitude in the zenith and bring it to the given azimuth; then turn the Globe round till the Star comes

to the Quadrant; the index will then shew the hour and the quadrant the altitude.

Q. The Altitude, the Latitude, and the day being given, how are the azimuth and time of night found?

A. Elevate the Globe for the Latitude, and bring the Sun's place to the meridian, and set the index to twelve. Having secured the quadrant as before, turn the globe till the Star cuts the quadrant at the given altitude; the index will then point to the hour, and on the horizon the quadrant will mark the azimuth.

Q. Suppose the azimuth, the hour, and the Latitude be given, and the Star's altitude and day of the month be required, how are they found?

A. Elevate the globe for the Latitude, fix the quadrant of altitude in the zenith, and bring it to the given azimuth. Bring the star to the edge of the quadrant, and set the index

to the given hour; the altitude of the star will be found on the quadrant. Turn the globe till the index points to noon; and the day of the month, which answers to the degree of the ecliptic cut by the brass Meridian, is the day required.

Q. If at a given Latitude two given stars be said to have the same azimuth, can the hour of the night be therefrom determined on the globe?

A. By first elevating the globe for the given latitude; bringing the Sun's place to the brass meridian, and setting the index to twelve. Then if the globe and quadrant be moved till the latter come over both stars—the index will point to the hour.

N. B. In actual observation it will be found easy to discover if two Stars have the same azimuth, by holding up a small line with a plummet, or observing them by any known perpendicular.

Q. Let any given star be named, and a day and place given; then I require the rising, setting, and culminating, of the star; its continuance above the horizon; its oblique ascen-

sion and descension; and its eastern and western amplitude.

A. The globe must first be elevated as before, for the latitude of the given place—the Sun's place brought to the meridian, and the index set to twelve. Then bring the given star to the eastern horizon, and the index will shew the hour of rising:—the degree of the equinoctial which rises with the star, is its oblique ascension, and the distance of the star from the eastern point of the horizon, is its eastern or rising amplitude. Move the star from the horizon to the meridian; and the index will shew its time of culminating. Move the star on, from the meridian to the western horizon, and its setting, oblique descension, and western or setting amplitude will be found in the same manner as its rising, oblique ascension, and eastern amplitude. The number of hours from rising to setting will be the time of its continuance above the horizon.

Q. How do you find what Stars never rise,

and what Stars never set, at any place?

A. Elevate the Globe for the Latitude of the place. Then by turning the Globe round it will readily be seen that those stars which do not in revolving descend below the horizon at the north points, never set,—and that those which do not in revolving appear above the Horizon at the southern point, never rise, at the place for which the globe is then elevated.

Q. Suppose it be wished to make the globe represent the face of the heavens in any given latitude, and in any given day and hour.

A. Elevate the globe for the latitude, bring the Sun's place to the meridian, and set the index to twelve. Then turn the globe till the index points to the given hour, and the stars in the heavens will appear exactly in the same situations as upon the globe.

Questions for Exercise in the First Chapter.

Required the right ascension of the following Stars.

1. Dubhe, the upper pointer in Ursa Major?

2. α Aldebaran —the southern eye of the Bull?

3. β Pollux, in the Constellation Gemini?

4. β, the north scale, a Star of the second magnitude in Libra?

5. α a Star of the second Magnitude in the tail of the Dragon?

6. γ a Star of the second magnitude in the wing of Pegasus?

7. Betelguese in Orion's Shoulder?

8. Sirius, the Dog Star?

9. Alruccabah, the north Polar Star?

10. Alphard, Hydra's Heart?

Required the Declination of the following Stars.

11. α Arietis of the second magnitude in the Ram's Horn?

12. β Tauri, the northern horn of the Bull?

13. ε Sagittarii, a Star of the second magnitude?

14. β Ursa Major, the lower pointer?

15. α Lyra, a Star of the first magnitude in the Harp?

16. α Capella, the Goat Star?

17. α Procyon, in Canis minor?

18. Fomalhaut, in the southern fish?

19. Spica Virginis, in the Constellation Virgo?

20. α the south scale, a Star of the second magnitude in the Constellation Libra?

Required the right ascension and declination of the following Stars, viz.

21. β Mirach, a Star of the second mag-

nitude in the Girdle of Andromeda?

22. α Menkar, a Star of the second magnitude in the Whale's Jaw?

23. β Algol, a Star of the second magnitude in Medusa's Head?

24. α Algenib, a Star of the second magnitude in the Constellation Perseus?

25. η in Pleiades, the brightest Star of the seven?

26. β Rigel, Orion's foot, a Star of the first magnitude?

27. γ Bellatrix in the left shoulder of Orion, a Star of the second magnitude?

28. ε a Star of the second magnitude in the Girdle of Orion?

29. α Castor, the first twin, a Star of the first magnitude?

30. α Arcturus, a Star of the first magnitude in the Constellation Bootes?

Required the right ascension of the following Stars: viz.

31. Regulus, a Star of the first magnitude in the Lion's Heart?

32. Antares, also of the first magnitude in the Scorpion?

33. Alioth of the second magnitude, in the Great Bear's tail?

34. Ras Algethi of the second magnitude in the Head of Hercules?

35. Rastaben, in the Dragon's Head, a Star of the second magnitude?

Required the Latitudes and Longitudes of the following Stars.

36. β Taurus. 37. Pollux. 38. Regulus. 39. Markab. 40. Vega. 41. Arided. 42. Schedar. 43. Enar Achamar. 44. β Scorpio. 45. Atair. 46. α Draco. 47. Capella. 48. Fomalhaut. 49. Procyon. 50. α Centaur. 51. Arcturus. 52. Dubhe. 53. Algol. 54. Aldebaran Tauri. 55. Spica Virginis.

56. Antares. 57. Rigel. 58. Canopus. 59. Castor. 60. Cor Scorpionis, α.

At what hours do the following stars come to the Meridian on Feb. 9th?—

61. Lyra. 62. Aldebaran. 63. Arcturus. 64. Capella. 65. Sirius. 66. Regulus. 67. Castor. 68. Fomalhaut. 69. Markab. 70. Atair.

Required at what time the following stars come to the Meridian on the respective days:

71. Regulus,	October 24.
72. Draco, α,	September 20.
73. Bellatrix,	January 7.
74. Cassiopeia, β,	November 8.
75. Ras Algethi,	August 22.
76. Menkar,	May 5.

At what hour does Alphard (Hydra's Heart) come to the Meridian on the following days?

77. January 29. 78. May 15. 79. August 12. 80. September 23. 81. November 5. 82. December 21.

At what hours do the following stars come to the meridian on the under-mentioned days?

83. Mirach, April 6. 84. Almach, June 21. 85. Algol, July 12. 86. Brightest of the seven stars, August 29. 87. Procyon, October 14. 88. Great Bear, α, December 26.

89. On what day does Algenib in Perseus come to the Meridian at midnight?

90. On what day does Spica Virginis come to the Meridian at half past nine in the evening?

On what days do the following stars come to the Meridian at midnight?

91. Algol, in Caput Medusæ. 92. Betelguese, in Orion, α. 93. Acubens, in Cancer, α. 94. Alioth, in the Great Bear, ε.

On what days do the following stars come to the Meridian at nine o'clock in the evening?

95. Ras Alhagus, in Serpentarius, α. 96. Rastaben, in the Dragon, γ. 97. Deneb, in Læo, β. 98. Scheat, in Pegasus, β.

Required the days on which the following Stars come to the Meridian, at five o'clock in the morning:

99. Sirius, in the Great Dog, α. 100. Aries, α. 101. Taurus, β. 102. The Great Bear, δ. 103. Serpent, α. 104. Andromeda, α.

On what days do the following stars come to the Meridian, at ten o'clock in the evening?

105. Orion, ε. 106. Acubens, in Cancer, α. 107. Alderamin, in Cepheus, α?

On what days does Arcturus come to the meridian, at the following hours?

108. Noon. 109. 3 p. m. 110. 9 p. m. 111. Midnight. 112. 3 a. m. 113. 6 a. m.

114. Required the altitude and azimuth of Cor Leonis, at London, on May 11th at 11 o'clock p. m.

115. Required the altitude and azimuth of Capella, at Rome, on December 2nd, at 5 in the morning.

What are the altitude and azimuth of the following Stars, at Newcastle, October 6th, at the following hours?

116. Arided, Midnight? 117. Capella, 8 p. m. 118. Castor, 10 p. m. 119. Algenib (α, Perseus), 8 p. m. 120. Menkar, 11 p. m. 121. Atair, 9 p. m. 122. Vega, 9 p. m. 123. Arcturus, 7 p. m.

Required the altitude and azimuth of the following stars, at London, December 21st, at 4 in the morning.

124. Spica Virginis. 125. Sirius. 126. Deneb (Leo,). 127. Cor Hydræ. 128. Procyon. 129. Pleiades (Taurus, η). 130. Arided (Cygnus, α).

Having the azimuth of the following Stars for Newcastle, on October 6th, required the hour and the altitude.

131. Brightest of the 7 stars,	S.	88½°	E.
132. Arcturus,	N.	81	W.
133. Aries, α,	S.	65	E.
134. Capella,	N.	40	E.

135. Auriga, β, N. 52° E.
136. Betelguese, S. 80 E.
137. Acubens (Cancer, α), S. 70 E.
138. Procyon, S. 29 E.

Having the altitudes of the following Stars at London, on the days of the months mentioned below, required the time and the azimuth.

139. Sept. 1, Ev. Benetnasch / Ursa Major, η, } Alt. 38°
140. Dec. 21, Morn. Deneb, Leo, β, 50
141. May 11, Ev. Regulus, 27
142. Sept. 1, Ev. Scheat Alp. Pegasus 47
143. May 11, Ev. Castor, 18
144. Dec. 21, Morn. Sirius, 8

145. At Rome, 5 o'clock a. m., the azimuth of Capella was N. 60° W.; required the day of the month and the altitude of the Star.

Required the hour at London when the following Stars have the same azimuth on the annexed days.

Days.	*Stars.*
46. Jan. 3,	Algol and Aldebaran.

Days.	*Stars.*
147. Feb. 6,	Cor Caroli and Arcturus.
148. May 12,	α, Cygnus, and α, Pegasus.
149. Nov. 15,	Castor and Cor Hydræ.

150. Required the time that Sirius rises at London on March 14th; also the time that it comes to the meridian, and when it sets; how long it continues above the horizon; likewise its oblique ascension and decension, and its eastern and western amplitude.

151. Required the same for Achernar in Eridanus, at Otaheite, on June 4th.

152. Required the same for Arcturus, at Newcastle, on March 11th.

153. Required the same for Rigel, at Jerusalem, on September 23d.

154. Required the same for Menkar, α, Cetus, at Rome, on October 12th.

155. Point out the situation of the Stars, for the latitude of Newcastle, on January 1st, at 8 o'clock in the evening.

156. What are the principal constellations that will be above the horizon of Edinburgh,

on May 1st, at 10 o'clock in the evening?

157. What constellations never set at Newcastle, and what principal Stars are always visible there?

158. What constellations never rise to Newcastle?

159. Are there any Stars that never set at Jamaica?

160. Are there any Stars that never rise at Otaheite?

161. How far north must I travel never to lose sight of Arcturus?

162. How far south of the Equator must those people live who never see any part of the Great Bear?

163. In what parallel of latitude must I be never to see Lyra?

164. Where must I go never to see Sirius?

165. Where must I go never to lose sight of Sirius?

End of the Questions in Chapter II.

CHAPTER III.

Of the Sun.

Section 1.

Introductory Questions.

Q. Where is the Sun placed, and with what attendants?

A. In the centre of the Solar system, surrounded by the planets moving round him at different distances and in various times.

Q. The diameter of the Sun?

A. About 883,217 miles; his solid content is 1,380,000 times that of the Earth; from which he is distant about 95 millions of miles.

Q. Why does he seem to move among the Stars in the Ecliptic?

A. This appearance is occasioned by the Earth's annual revolution round him; which causes a daily variation in his right ascension and declination. His amplitude and azimuth also vary both with the day of the month and latitude of the place.

Section 2.

Problems.

Q. How are the Sun's right ascension and declination found for any day?

A. Bring his place to the brass Meridian, then the degree over it shews the declination and the Equator gives the right ascension under the Meridian.

Q. How do you find the Sun's oblique ascension, ascensional difference, eastern amplitude, and time of rising, for any given day and place?

A. Elevate for the latitude, bring Sun's place to the Meridian, set the index to 12; move Sun's place to the eastern side of the Horizon, and the degree on the Equinoctial then at the Horizon will be the oblique ascension. The difference between it and the right ascension (to be found by the last Problem) will be the ascensional difference. The number of degrees on the Horizon intercepted between the east point and the Sun's place, will be the eastern or

rising amplitude, and the index (when the Sun is at the Horizon) will give the time of rising.

Q. How do you find the Sun's oblique descension, descensional difference, western amplitude, and time of setting, for any given day and place?

A. By the foregoing rule, only that the Sun's place must be brought to the western Horizon.

Q. How can you tell at what hour the Sun rises or sets?

A. By knowing his ascensional or descensional difference—thus; If the Sun's declination and the latitude of the place be of the *same* name, the ascensional difference reduced to time, and *subtracted from* six o'clock, will give the time of the Sun's rising. If the Sun's declination and latitude of the place be of *different* names, the ascensional difference *added to* six o'clock will give the rising. In the former case add the descensional difference to six for the setting, in the latter case subtract it.

Q. From having the latitude, hour of the day, and day of the month, given; how are the Sun's altitude and azimuth found?

A. Elevate for the latitude, bring the Sun's place to the meridian, and set the Index to 12, turn the globe till the Index points to the given hour. Fix the quadrant in the Zenith, and bring it over the Sun's place; then the degree upon the quadrant cut by the Sun's place will be its altitude; and the distance between the quadrant's foot and the north or south points of the Horizon will be the azimuth.

Q. How are the Sun's altitude and hour of the day found in a given latitude, from having the day of the month and the azimuth?

A. Rectify as in the last problem, fix the Quadrant in the Zenith, and bring it to the given azimuth. Turn till the Sun's place comes to the Quadrant; then the Index will shew the hour, and Quadrant the altitude.

Q. From having the Sun's altitude, day of the month, and latitude of the place, given, how

are the Sun's azimuth and hour of the day found?

A. Rectify as before; and having screwed the quadrant upon the Zenith, turn the globe, and move the quadrant till Sun's place cuts the quadrant at given altitude; then the Index will shew the hour, and the Quadrant the azimuth on the Horizon.

Q. From having the latitude, Sun's altitude and azimuth, given; how can you tell the day of the month and hour of the day?

A. Elevate the globe for the latitude, fix the quadrant upon the Zenith and bring it to the given Azimuth. Turn the Globe about, and that degree of the Ecliptic which cuts the quadrant at the given altitude will be the Sun's place; from which the day of the month may be found.—Keeping the quadrant in the same position, turn the Globe till the Sun's place comes to the Meridian, and set the Index to 12; then bring the Sun's place again to the Quadrant, and the Index will shew the hour.

The examples to this problem will admit of a double answer, unless it is known whether the Sun be in the ascending or descending Signs.

Questions for Exercise in Chapter III.

166. Required the Sun's right ascension and declination for the last day in each of the calendar Months.

167. What are the Sun's oblique ascension, ascensional difference, eastern amplitude, and time of rising, at the following times and places:—York, February 5th; Berlin, January 29th; Juan Fernandes, March 1st; Quito, June 21st; Samarcand, December 21st; Pegu, May 15th; Alexandria, August 10th; Bender, July 11th; Cape Horn, December 25th; Pelew Islands, November 5th?

168. Required the Sun's oblique descension, descensional difference, western amplitude, and time of setting, for the same places and times.

169. What are the Sun's altitude and azimuth at the following places and times?—

Copenhagen, March 5th, 10 a. m.

Marquesas, July 7th, 3 p. m.

Pekin, August 12th, 7 a. m.

Batavia, January 1st, 11 a. m.

Cape of Good Hope, December 21st, 6 p. m.

Guadaloupe, June 4th, 8½ a. m.

170. April 15th, in the afternoon, the Sun's altitude at Madrid was 50°; required the hour and the azimuth.

171. At London, on May the 1st, the Sun's azimuth was S. 44½° E.; required the hour and the Sun's altitude?

172. At Canton, on March 10th, the Sun's azimuth was S. 74° E; what were the hour and altitude?

173. At Jerusalem, on February 22nd, the Sun's azimuth was S. 55° E.; required the hour and altitude.

174. At Rome, on March 10th, the Sun's azimuth was S. E. 6° 24′ E.; required the hour and altitude.

175. In the latitude of 51½°, the Sun's altitude was observed to be 46½°, on June 21st, what were the Sun's azimuth and the hour when the observation was made?

176. At Oonalashka, on June 21st, in the

evening, the Sun's altitude was 10°; required the hour and the azimuth.

177. At London, what are the Sun's altitude, and the hour, when it is due East or West on the longest day?

178. At London, on June 21st, how far from the North does the Sun rise and set?

179. At Paris, on November 5th, in the evening, the Sun's altitude was 20°; required the hour and azimuth?

180. In the morning of June 21st, the Sun's altitude at London was 46° 20′; what was the hour?

181. The Sun being in the ascending signs, its altitude, at Newcastle, was observed to be 22°, when its azimuth was N. 87° W.; required the day of the month and the hour of the day.

182. At Stockholm, in the summer season, the Sun's altitude was 12°, when its azimuth was N. 63° E.; required the day of the month and hour of the day?

183. At Edinburgh, on June 21st, how far from the north does the Sun rise?

184. How many degrees are there between that point of the horizon in which the Sun rises at Newcastle on June 21st, and that point in which it rises on December 21st?

185. In what part of the horizon does the Sun rise at Quito, on June 21st and December 21st?

CHAPTER IV.

The Planets and their Satellites.

Section 1.

Introductory and Explanatory Questions.

Q. What are the Planets?

A. Celestial bodies revolving round the Sun. They are continually changing their place among the fixed Stars; with relation to which therefore they are, as their name implies, *wandering stars*:—Before Herschel's time, there were but six Planets known, viz. Mercury, Venus, the Earth, Mars, Jupiter, and Saturn: he discovered a seventh, which has been called Uranus, and by some astronomers Herschel,

after its discoverer*; but since 1801, four other Planets have been discovered—Ceres, Pallas, Juno, and Vesta.

Q. Do these Planets all revolve round the Sun, as their common Centre?

A. They all revolve round the Sun, at different distances, and at various rates of velocity. Two are nearer to the Sun than the Earth, and are called *inferior* Planets; these are Mercury and Venus. The rest are at a greater distance, and are called for that reason *superior* Planets; they succeed in the following order of proximity to the Sun: next to the Earth is Mars; then Ceres, Pallas, Juno, Vesta, Jupiter, Saturn, and Herschel; the distance of Mercury from the Sun is 37 millions of miles; that of the Earth 95 millions of miles; that of Herschel 1800 millions of miles.

Q. How do you know that the Planets Mercury and Venus are nearer to the Sun than our own Planet?

* Called also Georgium Sidus, in honour of the sovereign in whose reign it was discovered.

A. Because they are the only Planets which are never seen in opposition to the Sun; that is, they are never seen in the East, when the Sun is in the West; nor in the West, when the Sun is in the East; nor are they ever seen on the Meridian at Midnight. Besides which, they occasionally are seen to pass across the Sun's Disc like dark spots—which is never the case with the other Planets.

Q. How much do the Planets differ from each other in magnitude?

Q. The diameter of two of the eleven have not been ascertained; of the remaining nine, three are larger, five smaller, than the earth. Jupiter is the largest, his diameter being 90,000 miles; that of the earth, 7,970; that of Pallas, the smaller Planet, 80 miles.

Q. Are all the Planets supposed to be opaque?

A. It is obvious that they are so; because the inferior Planets, as before observed, appear like dark spots when seen passing the Sun's Disc; — Mars sometimes appears partially

dark;—Jupiter and Saturn cast shadows, and eclipse their Satellites.

Q. What are the Satellites?

A. They are the lesser Planets; called also *Secondary Planets*, which revolve round some of the larger or *primary* Planets, and so attend them in their revolution round the Sun.

Q. Which of the primary Planets are thus attended?

A. The Earth is accompanied and enlightened by one Satellite, the Moon; Jupiter has four, Saturn seven, and Herschel or Uranus six, Moons or Satellites.

Q. Of what use may we suppose Satellites to be?

A. To us the Satellites of other Planets are very useful in assisting various of our astronomical observations. Of their use to the Planets they respectively attend, we may judge from the great use we derive from our own attendant, the Moon.

Q. Of what use, then, is our Satellite to us?

A. Her light frequently supplies the absence of the Sun; her motion affords a measure of time; her influence affects our tides.

Q. What is the Harvest Moon?

A. "The Moon rises about three quarters of an hour later on that day than on the day preceding; but in places of considerable latitude, as that in which we live, there is a remarkable difference about the time of harvest, when, at the season of full Moon, it rises, for several nights together, only about 17 minutes later on one day that on the day preceding. By thus succeeding the Sun before the twilight is ended, the Moon prolongs the light, to the great benefit of those who are engaged in gathering the fruits of the Earth; and hence the full Moon, at this season, is called the *Harvest Moon*. The full Moon nearest the vernal equinox rises with the greatest difference of time, viz. an hour and a quarter later every day than on the former."

Q. The Moon moves round the Earth—

but is the orbit in which she moves on the same plane with the Ecliptic?

A. No: the plane of her orbit makes an angle of about 5°, with the Ecliptic.

Q. What are the Moon's *Nodes?*

A. The Moon's Nodes are the points at which her orbit crosses the Ecliptic.

Q. Are those points fixed?

A. No: they are constantly changing. It appears from observation that the line of the Nodes constantly changes its place by a retrograde motion, i. e. from East to West, at the rate of about 19° in a year; so that they would, in about 19 years, regain the same point. This retrograde motion of the Moon's Nodes has been shewn by Newton to arise from the influence of the Sun.

Section 2.

Problems.

Q. As the Planets move round the Sun, and appear, of course, to be continually changing their situations among the fixed

Stars, how do you mark their places on the celestial globe?

A. It is first necessary to ascertain the Latitude and Longitude of the Planet, on the day given; which are found by calculation, but may be seen on reference to the tables given for that purpose in White's Ephemeris. Knowing the Latitude and Longitude, you have only to fix a patch, marked with the character of the Planet, on that spot of the globe which has the given Latitude and Longitude, and by a series of such marks, the path of the planet through the heavens is easily and clearly traced on the globe.

Q. How may the rising and setting, azimuth, altitude, &c. be found for any given day, at any given place?

A. The situation of the Planet being marked on the globe, for the given day, the right ascension and declination, rising, culminating, and setting, amplitude, azimuth, and altitude, will be found in the same way as for the fixed Stars.

Q. How do you find when Jupiter and Venus are morning and when they are evening Stars?

A. Find their situation as before. If it be to the East of the Sun's place, they will be evening Stars—if to the West, they will be morning Stars.

Q. How do you mark on the Globe the Moon's Orbit for any given time?

A. Find the Moon's ascending Node in White's Ephemeris; the descending Node will of course be 180° distant from that. At the distance of 90° from those Nodes, reckoning each way, count $5\frac{1}{4}$° to the north of the Ecliptic on one side, and $5\frac{1}{4}$° to the South on the other side. Fasten a silk line round the Globe to cut the Ecliptic at the Nodes, and to pass over those two points, made at the distance of $5\frac{1}{4}$° on each side of the Ecliptic; this will represent the Moon's Orbit for the given day.

Q. How to find the Moon's Diurnal motion in the Ecliptic for any given day?

A. By ascertaining (from the Ephemeris) the difference between the longitudes of the Moon on the given or preceding day.

Q. How do you mark on the Globe the Moon's place in the heavens for any given day and hour?

A. Its Longitude for the given hour must first be found by the Rule of Three, from the quantity of its daily motion, its latitude from White's Ephemeris; put a small patch (with the Moon's astronomical character marked on it) on the place of its habitation and longitude, and this patch will represent the Moon.

Q. How is the time of the Moon's rising, southing, and setting, found for any latitude and given day of the year?

A. In the same way as that of the Stars—the Moon's place having first been ascertained and marked by a patch on the Globe as above.

Q. What is the meaning of *Epact*, and how is it found?

A. Epact is the difference between solar and lunar years and months. It is found by

this rule:—divide the year by 19, multiply the remainder by 11, and divide the product by 30; the remainder will be the Epact.

Q. How is the Moon's age found?

A. Add the Epact of the year, the Epact of the month, and the day of the month; the sum (if less than 30) is the Moon's age: if above 30, divide by 30, and the remainder will be the Moon's age.

Q. How do you determine the Moon's Southing?

A. Multiply the Moon's age by four, divide the product by five; the quotient is hours; and the remainder, multiplied by twelve, gives minutes. If the hours be more than twelve, take twelve away, and the remainder is the time of the Moon's Southing after last midnight, nearly.

Q. How to find the time of the Year, when the Moon (or the Sun) will be eclipsed?

A. Compare the Sun's Longitude, at the time of full Moon, with the place of the Moon's

Nodes; and if it be within 12°, there will be an Eclipse of the Moon. Compare the same at the time of new Moon; and if it be within 18°, there will be an Eclipse of the Sun.

Q. How do you explain, by the Globe, the phenomena of the Harvest Moon?

A. Elevate the globe for any Northern Latitude, suppose for Newcastle.

In September, when the Sun is in the beginning of Libra, the Moon, at full, must be in or near the beginning of Aries; and as the mean motion of the Moon is 13° in a day, put a patch on the first point of Aries; and another 13° beyond it, on the Ecliptic: this last will point out the Moon's place the first night after full. Its place on the second, third, &c. night, may be found by putting more patches at the distance of 13° from each other.

Bring the first patch to the horizon, and observe the hour: turn the globe till the second patch comes to the Horizon, and the Index will shew that it rises only 17 minutes later than

the former. Thus 17 minutes is the difference of the Moon's rising on two successive nights. And the other patches will successively come to the Horizon in little more than that time after each other; which shews that the difference of the Moon's rising several nights successively is little more than 17 minutes for each night. The difference of the Moon's rising for a week will not be two hours.

Q. What do you understand by the term *Equation of Time;* and how can it be explained by the globe?

A. *Mean* or *equal* time is measured by a clock that is supposed to go without variation, and to measure exactly 24 hours from noon to noon. *Apparent* time is that time as measured by a good sun-dial.

The Sun's motion being in the Ecliptic, and not in the Equator, and equal portions of the Ecliptic passing over the Meridian in unequal times, causes a difference between *equal* and *apparent* time: the adjustment of this difference is called the Equation of Time.

To shew this upon the globe, make pencil marks all round the Equator and Ecliptic, at equal distances (suppose 15°) from each other, beginning with Aries.

Then on turning the globe, you will perceive that all the marks on the first quadrant of the Ecliptic, that is, from Aries to Cancer, come sooner to the brass Meridian than their corresponding marks on the Equator. Time, as measured by the dial, is represented by marks on the Ecliptic; that measured by a good clock by those on the Equator: hence, whilst the Sun is in the first quarter of the Ecliptic, the dial is faster than the clock.

On turning the globe, it will be found that the marks on the second quarter of the ecliptic, that is, from Cancer to Libra, come to the Meridian later than those on the Equator; and consequently the Sun is slower than the clock. In the same manner it will be seen, that in the third quarter, from Libra to Capricorn, the Sun is faster; and in the fourth

quarter, from Capricorn to Aries, slower than the clock.

CHAPTER V.

Of Comets.

Q. What are the Comets?

A. They are celestial Bodies, whose movements are so eccentric, and which have so rarely become visible, that comparatively little is known of them. They are however supposed to be, like the planets, opaque bodies, revolving round the Sun; they differ from the planets in their orbits, which are elliptical and eccentric.

Q. What is there remarkable in the appearance of Comets?

A. Comets of various and singular figures have at different times made their appearance. But they have usually, though not invariably, been attended by a train or tail; whence their name.

Q. Of what use may Comets be supposed to be?

A. This is difficult to answer. In early times they were regarded with superstition: being considered as portentous and supernatural prodigies, sent to give warning of some dire and impending calamity. Comets undoubtedly form a part in the immense plan of creation: but of the part they occupy and the use for which they exist—we are ignorant.

Q. How many Comets are supposed to exist?

A. 450 have been said to attend our solar system.

Q. Do they move like other planets in the order of the signs?

A. Some do: but nearly as many have a retrograde motion.

Q. How can the situation of any of these bodies be marked on the Globe?

A. It will be requisite first to ascertain the Comet's altitude and azimuth. Having these,

rectify the Globe for the place and time of observation: thus; elévate for the latitude of the place, and fix the quadrant of altitude in the Zenith; bring the Sun's place for the given day to the meridian and set the Index to 12. The Globe being thus rectified, turn it about towards the East till the Hour Index points to the given time; then bring the quadrant of altitude to intersect the Horizon in the given Azimuth of the Comet. Then, under the given altitude, place a patch which will represent the Comet.

Q. How do you find the Latitude, Longitude, Declination, and Right Ascension, and shew the time of rising, southing, and setting, and the Amplitude of a Comet, for a given day?

A. The Latitude, Longitude, Declination, and Right Ascension, the time of rising, &c.&c. of a Comet, are determined by the same rule as those of a Star occupying the place of the *Cometary* patch.

Q. From two given places of the Comet, how can its apparent path among the Stars be assigned?

A. Having denoted the two places or patches, move the Globe up and down till both places coincide with the Horizon: a line drawn with a pen or pencil, or marked by a row of patches, agreeing with the line of the Horizon, from one given place to the other, will decline at the required path.

The Frontispiece represents the Constellations marked upon an ancient Globe on a Statue of Atlas in the Farnese Palace at Rome. "It is perhaps the only *Celestial Globe*, with the figures upon it, in the true ancient manner, in the World."

In this Globe, the two bears, and Southern fish, are supposed to have been obliterated by the damages it has sustained; it contains, including these three, all the 48 Ancient Constellations, of which an explanatory table is subjoined, except five: viz. Lupus, Equulus, Triangulum, Coma Berenices, Antinous. Besides which there are two Constellations on the Farnese Globe—which do not seem to have been included in any more recent catalogues.

Names of Constellations.	Their probable Origin and Import.	Grecian Appropriation.
Aries.	Chaldean, Ram. Egyptian, Jupiter Hammon.	The Ram from which Jason obtained the fleece, brilliant as gold.
Taurus.	Chaldean, Bull. Egyptian, Apis, Osiris.	The Bull, containing the Pleiades & Hyades, daughters of Atlas.
Gemini.	Chaldean and Persian, two Kids. Egyptian, Hercules and Apollo.	Castor and Pollux.
Cancer.	The Egyptian Taut.	The Sea-crab sent to annoy Hercules.
Leo.	Egyptian symbol of solar heat.	The Nemæan Lion.
Virgo.	Noah's Consort. Babylonian Venus. Egyptian Isis.	The Grecian Astræa.
Libra.	An Egyptian utensil employed in measuring the waters of the Nile.	The Scales of Astræa.
Scorpio.	The Egyptian Typhon, the enemy of Osiris.	The Scorpion that stung Orion.
Sagittarius.	The Armour-bearer of Osiris, darting his arrows at the Scorpion; the origin of the fable of Apollo, shooting his 1000 darts on the Serpent Typhon.	
Capricornus.	An Egyptian compound, expressive of the course of the sun, and of descending rains.	The Goat which climbs the mountains an emblem of the ascent of the Sun.
Aquarius.	Chaldean, general Deluge. Egyptian, Nile.	Ganymede, Cupbearer to the Gods.
Pisces.	Among the Chaldeans, Egyptians, and Hindoos, half a human and half a bestial form. Noah.	Venus and her Son.
Ursa Minor.	Phœnician, the little Wagon.	The residence of the Son of Diana's nymph Callistho.
Ursa Major.	Chaldean, the Wagon called by the Hindoos the Great Constellation.	Callistho.

Draco.	Egyptian, the old Serpent.	The Dragon of the Hesperides.
Auriga.	Probably allusive to the Comet which occasioned the deluge, and the origin of the fable of Phaeton	The Charioteer.
Perseus.	Chaldean.	The Combatant with the three Gorgons.
Cepheus.	Egyptian. Egypt.	King of Ethiopia & one of the Argonauts.
Cassiopeia.	Egyptian. Perseverance contending with the inundation of the Nile.	The wife of Cepheus.
Andromeda.	Egyptian. The Nile, beautiful when bound.	The Daughter of Cepheus & Cassiopeia.
Cygnus.	- - - - - - - - - - - - - - - - - -	One of the forms assumed by Jupiter.
Serpentarius & Serpens.	Egyptian. The old Serpent, and He who should curb his power.	Esculapius, and one of the tribe formerly used in medicine.
Hercules.	Phœnician. The Deliverer. Nimrod.	The great hero of antiquity executing twelve wonders.
Sagitta.	The Arrow of Hercules.	
Aquila.	- - - - - - - - - - - - - - - - - -	Merops, King of Cos.
Antinous.	- - - - - - - - - - - - - - - - - -	A favourite of the Emperor Adrian.
Delphinus.	Egyptian, Thus honored for great service to Neptune.	
Lyra.	The Harp of Jubal—of the Indian Apollo.	Of the Greek Orpheus.
Coma Berenices.	Egyptian. The Hair of Berenice, wife of Ptolemy.	
Equulus.	A young horse both on the Hindoo & Grecian Spheres.	
Pegasus.	Chaldean. The fall of Adam.	The fall of Bellerophon.
Triangle.	Egyptian. The Δ Delta of the Nile.	
Boötes.	Chaldean. Noah.	Boötes.
Corona Australis.	The Crown of Noah's Armour-bearer.	A wreath round the leg of Sagittarius.
Centaurus.	Chaldean. Noah.	Chiron, the son of Saturn.
Lupus.	Chaldean. The Beast sacrificed.	The Wolf.
Ara.	Chaldean. Noah's Altar.	Altar of Cyclops on which the gods swore.
Argo.	Phœnician. Noah's Ark. Canopus Japhet. Also the Egyptian God of Mariners.	Argo Navis. Canopus, the Greek Neptune.

Table of Ancient Constellations—continued.

Name of Constellations.	Their probable Origin and Import.	Grecian Appropriation.
Hydra.	The Flood. Egyptian, the Nile.	100-headed Monster in the lake Lerna.
Corvus.	Egyptian. Noah's Raven. The Pleiades, Noah'sDove	The crow of Apollo.
Crater.	Egyptian. Noah's Vase.	The bowl of Bacchus.
Eridanus.	Chaldean. The asterism of the river. The river of Nimrod or Orion.	The Po in Italy.
Orion.	Chaldean. Nimrod.	The gift of Jupiter Neptune, and Mercury, to Hireus.
Lepus.	Chaldean. The Hare, illustrative of the character of Nimrod and of Orion.	
Canis Major.	The great dog of Nimrod. To the Egyptians a symbol of Syrius the Dog Star, the celestial barker. The consort of Noah has a residence in the dog's head.	One of Orion's Hounds.
Canis Minor.	The forerunner of the greater Dog.	Another of Orion's Hounds.
Cetus.	Egyptian. The unexpected inundations of the Nile.	The Monster to devour Andromeda.
Piscis Australis.	Probably some reference to the Deluge.	The form Venus took to escape the fury of Typhon.
Sun.	Noah. Among the ancient Persians, Shem had this honorable station assigned him.	
Moon.	The Ark.	
Saturn.	Noah.	
Jupiter.	Ham, the son of Noah, the Jupiter Hammon of antiquity, the founder of the Egyptian Nation.	
Mars.	Nimrod.	
Venus.	Semiramis.	
Mercury.	Phuth, the third son of Ham.	

ANSWERS

to the Questions contained in the Catechism of

THE CELESTIAL GLOBE.

1. 162° 49′	2. 66° 0′	3. 113° 15′
4. 226 30	5. 209 30	6. 0 44
7. 86 0	8. 99 0	9. 13 0
10. 139 15	11. 22 30 N.	12. 28 25 N.
13. 35 0 S.	14. 57 27 N.	15. 38 36 N.
16. 45 47 N.	17. 5 44 N.	18. 30 40 S.
19. 10 7 S.	20. 15 12 S.	

	Rt. Asc.	*Declin.*		*Rt. Asc.*	*Declin.*
21.	14° 30′	34° 33′ N.	22.	42° 45′	3° 18′ N.
23.	43 45	40 10 N.	24.	47 30	49 8 N.
25.	53 45	23 28 N.	26.	76 0	8 26 S.
27.	78 30	6 9 N.	28.	81 30	1 20 S.
29.	110 15	32 18 N.	30.	211 30	20 13 N.

31. 9 h. 57 m.	32. 16 h. 17 m.	33. 12 h. 45 m.
34. 17 h. 5 m.	35. 17 h. 52 m.	

36.	5° 22′	N.	19° 47′	♊	37.	6° 40′	N.	20° 28′ ♋
38.	0 28	N.	27 3	♌	39.	19 30	N.	20 0 ♓
40.	62 0	N.	12 0	♍	41.	60 0	N.	2 0 ♓
42.	47 0	N.	4 0	♉	43.	60 0	S.	12 0 ♓
44.	1 2	N.	0 23	♐	45.	30 0	N.	27 0 ♍
46.	66 0	N.	4 0	♍	47.	23 0	N.	18 30 ♊
48.	20 30	S.	1 0	♓	49.	16 0	S.	22 0 ♋
50.	42 30	S.	26 0	♏	51.	31 0	N.	22 0 ♑
52.	49 30	N.	11 0	♌	53.	23 0	N.	22 0 ♉
54.	5 29	S.	6 59	♊	55.	2 2	S.	21 3 ♑
56.	5 0	S.	6 0	♐	57.	31 0	S.	13 0 ♊
58.	76 0	S.	11 30	♋	59.	10 0	N.	17 0 ♋
60.	4 30	S.	7 0	♐				

61. 9 h. 1 m. *a. m.*
62. 6 h. 55 m. *p. m.*
63. 4 h. 37 m. *a. m.*
64. 7 h. 33 m. *p. m.*
65. 9 h. 7 m. *p. m.*
66. 0 h. 28 m. *a. m.*
67. 9 h. 52 m. *p. m.*
68. 4 h. 17 m *p. m.*
69. 1 h. 25 m. *p. m.*
70. 10 h. 12 m. *a. m.*
71. 8 h. 6 m. *a. m.*
72. 2 h. 14 m. *p. m.*
73. 10 h. 5 m. *p. m.*
74. 9 h. 8 m. *p. m.*
75. 7 h. 5 m. *p. m.*
76. 0 h. 5 m. *p. m.*
77. 0 h. 34 m. *a. m.*
78. 5 h. 53 m. *p. m.*
79. 11 h. 54 m. *a. m.*
80. 9 h. 19 m. *a. m.*
81. 6 h. 39 m. *a. m.*
82. 3 h. 24 m. *a. m.*
83. Noon.
84. 7 h. 55 m. *a. m.*
85. 7 h. 33 m. *a. m.*
86. 5 h. 8 m. *a. m.*
87. 6 h. 15 m. *a. m.*
88. 4 h. 34 m. *a. m.*

89. Nov. 13
90. May 18
91. Nov. 8
92. Dec. 19
93. Jan. 30
94. April 3
95. July 28
96. Aug. 4
97. May 3
98. Oct. 21
99. Oct. 20
100. Aug. 4
101. Sept. 28
102. Jan. 6
103. Feb. 26
104. July 6
105. Jan. 11
106. March 1
107. Sept. 11
108. Oct. 28
109. Sept. 9
110. June 10
111. April 25
112. March 6
113. Jan. 20

	Alt.	Az.		Alt.	Az.
114.	26° 50′	S. 76° 30′ W.	115.	42°	N. 60° W.
116.	52	N. 77 W.	117.	21	N. 38 E.
118.	8	N. 43 E.	119.	36	N. 52 E.
120.	27	S. 52 E.	121.	38	S. 38 W.
122.	55	S. 85 W.	123.	20	N. 82 W.
124.	15	S. 50 E.	125.	49	S 37 E.
126.	30	S. 14 W.	127.	36	S. 46 W.
128.	10	S. 48 W.	129.	16	N. 71 W.
130.	8	N. 16 E.			

	Alt.			*Alt.*	
131.	30°	10 h. *p. m.*	132.	20°	7 h. *p. m.*
133.	43	10 h. *p. m.*	134.	22	8 h. *p. m.*

135. *Alt.* 30 10 h. *p. m.*
136. *Alt.* 15 midnight
137. 28 4 h. *a. m.*
138. 37 5 h. *a. m.*

		Azimuth.	*hr.*
139.		N. 52 W.	9
140.	{	S. 37 E.	4
	{	S. 37 W.	7½
141.	{	S. 76 W.	11
	{	S. 76 E.	2½
142.		S. 73 E.	9
143.		N. 59 W.	11
144.		S. 51 W.	4
145.	{	47 Alt. Nov.	29
	{	81 Alt. Oct.	8

146. 6 h. 15 m. *p. m.*
147. { 9 h. 15 m. *p. m.* / 1 h. 30 m. *a. m.*
148. 4 h. 0 m. *a. m.*
149. 1 h. 45 m. *a. m.*

150. Rises at 2 h. 24 m. *p. m.*
Culminates 6 h. 57 m. *p. m.*
Sets 11 h. 30 m. *p. m.*
Above the Horizon 9 h. 6 m.
Oblique Ascension 120° 47′
Oblique Descension 77 17
Amplitude 27 S.

151. Rises 30 m. *a. m.*
Culminates 8 h. 45 m. *a. m.*
Sets 4 h. 45 m. *p. m.*
Above the Horizon 16 h. 15 m.
Oblique Ascension 351°
Oblique Descension 54
Amplitude 64 S.

152. Rises 6 h. 35. m *p. m.*
Culminates 2 h. 35 m. *a. m.*
Sets 11 h. *a. m.*
Above the Horizon 16 h. 25 m.
Oblique Ascension 180°
Oblique Descension 244
Amplitude 36 N.

153. Rises 11 h. 30 m. *p. m.*
Culminates 5 h. 0 m. *a. m.*
Sets 10 h. 45 m. *a. m.*

	Above the Horizon	11 h. 15 m.
	Oblique Ascension	80°
	Oblique Descension	71°
	Amplitude	10°
154.	Rises	7 h. 35 m. *p. m.*
	Culminates	1 h. 45 m. *a. m.*
	Sets	8 h. 0 m. *a. m.*
	Above the Horizon	12 h. 25 m.
	Oblique Ascension	40°
	Oblique Descension	46°
	Amplitude	4° N.

Answers 155 *and* 156 *omitted.*

157. *Constellations:*—Ursa Major, part of Auriga, Perseus, part of Andromeda Cassiopeia, Cepheus, Cygnus, Lyra, Draco, part of Hercules, Ursa Minor, part of Boötes. *Stars:*—Lyra, Arided, Alderamiu, Almaack, Algol, Capella, Dubhe, Alioth, Benetnasch.

158. Phœnix, Eridanus, Horologium, Cela Praxitelis, Equuleus Pictorius, Dorado, Argo Navis, Piscis Volans, Centaurus, Crux, Chameleon, Lupus, Norma, Indus, Triangulum Australe, Ara, Telescopium, Pavo, Grus.

159. Ursa Minor, part of Cepheus, part of Camelopardalus. 160. Those which never set at Jamaica.
161. 69° 47′N.L. 162. 45° 0′S.L. 163. 51°24′S.L.
164. 73 33 N.L. 165. 73 33 S.L.

Answers 166 *to* 169 *omitted.*

170.	Hour 2 h. 15 m.	Azimuth S. 52° W.
171.	Hour 10 h. 0 m.	Altitude 47
172.	Hour 8 h. 0 m. *a. m.*	Altitude 25
173.	Hour 8 h. 45 m. *a. m.*	Altitude 28
174.	Hour 9 h. 0 m. *a. m.*	Altitude 30

Answers 175 *to the End omitted.*

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